Code of Practice for

Working Safely at Height

Code of Practice for Working Safely at Height

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Section A: General Requirements

1. Introduction

1.1 Title

1.1.1 The title of this document is called the Code of Practice for Working Safely at Height.

1.2 Scope

1.2.1 This Code of Practice provides practical guidance on the measures and good practices required to prevent persons from falling while working at height. The recommendations in this Code of Practice are suitable across all industry sectors.

1.2.2 Working at depth carries similar risks as working at height and as such, this Code of Practice will also be relevant. However, users of this Code need to be aware that persons working at depth are also exposed to other significant hazards such as escaping gases, collapsing sides and falling objects which are not covered by this Code of Practice.

1.3 Purpose

1.3.1 The objective of this Code of Practice is to enhance the standard of safety in workplaces where there is a risk of falling from height or into depth. This Code of Practice emphasises the use of the risk management framework to identify and control the hazards associated with work activities carried out at height.

1.3.2 This Code also describes and illustrates a variety of fall control measures and devices which can be adopted for use when risk of falling is present. However, users of this code should be aware that new developments in fall controls are constantly being introduced and it is not the intent of this code to limit or prohibit the use of new methods or devices in fall prevention.

1.4 Terms and Definitions

1.4.1 '**Administrative controls**' means policies and procedures for safe work practices.

1.4.2 '**Anchorage**' means a secure point of attachment for lifelines or lanyards.

1.4.3 '**Competent person**', in relation to any work to be carried out, means a person who has sufficient experience and training to perform the work.

1.4.4 '**Fall arrest system**' means equipment and/or material that is designed for the purpose of preventing, or reducing the severity of injury to a person in the event of a fall such as safety harness systems. Safety belts are generally used in a travel restraint system and not as a fall arrest system.

1.4.5 '**Fall protection plan**' means a site-specific plan prepared by a competent person for the purpose of reducing or eliminating the risk of falls by ensuring that all reasonable fall protection measures and methods have been implemented, prior to the commencement of work.

1.4.6 '**Fall protection system**' means material and/or equipment that is designed for the purpose of preventing a person falling from height such as scaffolds and mobile elevated work platforms.

1.4.7 '**Hazard**' refers to any source or situation with potential to cause injury or harm to the health of a person.

1.4.8 '**Individual fall arrest system**' means a system used to arrest the user in a fall. Such a system typically consists of a body harness and includes a lanyard, lifeline, anchorage or any suitable combinations of these.

1.4.9 '**Lanyard**' means a flexible line of rope, wire rope or strap, which generally is used for connecting the safety belt or safety harness to a lifeline or anchorage.

1.4.10 **'Lifeline**' means an anchored, flexible line that is used in conjunction with fall arrest systems to provide protection from falls.

1.4.11 '**Risk**' means the probability and consequence of injury or illness. Where possible, risk should be mitigated at source (design for safety), during the design and subsequently in the construction stages.

1.4.12 '**Toe-board**' means a low protective barrier that prevents the fall of personnel, materials and equipment to lower levels.

1.4.13 '**Travel restraint**' or '**work restraint**' system means methods of preventing a person from reaching beyond the safe work zone within which he will not be in danger of falling. For example, safety belt with lanyard of limited length attached to a suitable lifeline or anchorage.

2. Design for Safety

2.1 Risk Elimination and Reduction at Source

2.1.1 The purpose of designing for safety is to eliminate or reduce risk at source by taking into consideration foreseeable risks at the planning and design stage so that these risks can be removed, or mitigated by designing around the risk.

2.1.2 In identifying the foreseeable risks, the work activities of persons involved in the following areas should be taken into consideration:

- Construction and/or installation
- Usage
- Maintenance and/or cleaning
- Demolition and/or decommission

2.1.3 It is also important to consider risks that are posed to persons not directly involved but affected by the work such as visitors, customers or members of the public.

Design for Safety

To facilitate the design for safety for buildings and structures, a Design Review Process is recommended. It is a systematic process where the risks of the design are highlighted, reviewed and recorded.

In a Design Review Process, a safety and health review committee is established and should consist of the main stakeholders such as client, design engineer, architect, project safety and health coordinator and contractor.

The outcome of the review process should be a safe design endorsed by all parties and a record of the resultant hazards or vital safety and health information. A GUIDE process is recommended to assist in the review process.

G – Group together a review team consisting of major stakeholders.

U – Understand the full design concept by looking at the drawings and calculations, or have the designers elaborate on the design.

I – Identify the risks that arise as a result of the design or construction method. The risks should be recorded and analysed to see if they can be eliminated by changing the design.

D – Design around the risks identified to eliminate or to mitigate the risks.

E – Enter all the information including all vital design change information affecting safety and health or remaining risks to be mitigated into the safety and health risk register.

More information on design for safety and the GUIDE process can be obtained from the Guidelines on Design for Safety in Buildings and Structures[1] available at Workplace Safety and Health Council website (www.wshc.gov.sg).

[1] Workplace Safety and Health Council, Guidelines on Design for Safety in Buildings and Structures, Workplace Safety and Health Council, 2008

3. Fall Protection Plan

3.1 Implementing a Fall Protection Plan

3.1.1 A fall protection plan is a site specific plan that is designed to be integrated into the Safety and Health Management System. It provides a systematic approach towards eliminating or reducing the risk of falling from height by ensuring that all reasonable fall protection measures and methods have been taken prior to the commencement of the work.

3.1.2 All workplaces engaged in activities that require workers to work at height shall develop and implement a fall protection plan to ensure the safety of the workers during their course of work.

3.1.3 The fall protection plan is to be developed by a competent person. Provisions must also be made for adequate supervision to ensure that the plan is being implemented at the workplace.

3.1.4 The fall protection plan shall be monitored and reviewed periodically to ensure its relevancy and effectiveness. It is also required to be properly documented and kept readily available at the workplace.

3.2 Components of a Fall Protection Plan

3.2.1 The fall protection plan should be customised to address the unique conditions at individual workplaces.

3.2.2 A comprehensive fall protection plan should include (but not be limited to) the following components.

a) Policy for fall protection
b) Responsibilities
c) Hazard identification and risk assessment
d) Control measures/methods
e) Procedures
f) Personal fall protection equipment
g) Inspection and maintenance
h) Training
i) Incident investigations
j) Emergency preparedness

4. Policy for Fall Protection

4.1 A policy for fall protection will set clear and unambiguous terms on the organisation's approach and commitment towards fall prevention.

4.2 Top management with executive or site responsibility shall define, endorse and document its policy for fall protection. The policy for fall protection shall be appropriate to the needs, nature and scale of the organisation's activities and work at height risks.

4.3 The organisation shall establish a policy which demonstrates its commitments to prevent falls from height incidents, comply with applicable legal and other requirements.

4.4 It is important that the policy for fall protection is understood, implemented and maintained at all levels of the organisation. The policy for fall protection should be reviewed periodically and amended as and when necessary.

5. Responsibilities

5.1 Top management needs to ensure that sufficient resources essential to the establishment, implementation and maintenance of the fall protection plan are made available so as to achieve its objectives.

5.2 Competent person(s) shall be appointed to develop, implement, maintain and evaluate the fall protection plan. The fall protection plan must be developed specific to the conditions of the premises, i.e. on a site by site basis.

5.3 The appointed competent person(s) shall define, document and communicate the roles, responsibilities and accountabilities of all levels of staff that may be affected by the fall protection plan. It shall include the following:

- To evaluate the need to work at height;
- To ensure all reasonably practicable measures and methods are taken to eliminate potential falling from height hazards;
- To ensure all workers (inclusive of subcontractor workers) are properly trained in the use, maintenance and care of personal fall protection equipment and the recognition of hazards related to their use;
- To ensure all devices/equipment/materials used for fall protection by workers ((inclusive of subcontractor workers) are maintained at design specifications and are inspected/certified as per manufacturer and/or local regulatory/approved standards;
- To implement emergency response procedures and to investigate all falls from height incidents; and
- To ensure compliance with all applicable regulatory requirements and reporting of performance to top management for review.

6. Risk Management

6.1 Hazard Identification and Risk Assessment

6.1.1 Hazard identification and risk assessment is a fundamental tool to identify hazards associated with the workplace activities, assess its risk levels and determine the suitable control measures to be taken.

6.1.2 Employers, principals (including contractor and sub-contractor) and self employed persons are required to discharge their duties in identifying the hazards and conducting risk assessment in relation to the safety and health risks posed in the workplace, and to take all reasonably practicable measures to ensure that any person who may be affected by his undertaking is safe in the workplace.

6.1.3 Risk assessment should be conducted by a multi-disciplinary team who have a thorough knowledge of the work to be undertaken. The team members should include management staff, process or facility engineers, technical personnel, supervisors, safety personnel and workers whenever appropriate.

6.1.4 Hazard identification and risk assessment should be reviewed periodically to ensure its effectiveness and validity, particularly when there is any significant change to the workplace activities; or when there is an occurrence of any fall from height incident.

6.1.5 Risk management involves identifying hazards, assessing risks, implementing appropriate control measures, and monitoring and reviewing those measures.

6.2 Hazard Identification

6.2.1 Identifying hazards involves recognising any work process, activity or situation with potential to cause injury or harm to a person such as when a person works at the edge of a building without proper barricades.

6.2.2 It is important to plan the process for hazard identification and risk assessment. While the focus of this Code of Practice is on the hazards of falling when working at heights, it is also important to address and extend to other workplace safety and health hazards such as manual handling, noise, hazardous substances, falling objects and slips and trips.

6.2.3 All hazards to which a person (including members of the public) could be exposed to as a result of work must be identified. The hazards must always be identified prior to work commencement and when changes to systems of work are planned or occur. Examples of workplace conditions that could have potential falls from height hazards are given in the list.

Work Environments that Pose a Fall from Height Risk

- Raised work surfaces such as slopes;
- Slippery work surfaces (wet, oily, dusty or glazed);
- Uneven work surfaces (for example, broken ground or profiled roof sheeting);
- Cramped work surfaces;
- Work surfaces cluttered with tools, work materials and debris;
- Workers working in adverse weather conditions – for example in rain, strong or gusty winds, extreme heat or high humidity, or very cold conditions;
- Unprotected edges;
- Building materials, large tools, or equipment that need to be manually carried;
- Overloading of working platform, which may lead to collapse;
- Struck by moving object or equipment e.g. load from lifting operation.

6.2.4 There are various ways to identify potential hazards or situations that may result in a fall. Typically, consideration should be given to the following areas:

- Previous injuries, 'near miss' incidents or accidents involving the fall of persons that had occurred at the workplace or other similar workplaces;
- Relevant codes of practice and guidance notes;
- Consultation with stakeholders to find out what risks they may be exposed to when working at height. These stakeholders should include safety and health personnel, supervisors, engineers and technical personnel and workers;
- Walk-through inspections of the workplace; and
- Any other records or statistics which indicate potentially unsafe work practices.

6.2.5 A hazard identification process or procedure may range from a simple checklist for specific equipment, such as a ladder or fall arrest system, to a more open-ended appraisal of a group of related work processes. Generally a combination of methods will provide the most effective results.

6.3 Risk Assessment

6.3.1 Assessing risks of working at height involves looking at the likelihood of a fall occurring and the extent of any potential harm or injury (i.e. the consequences) and consequently, determine a level of risk. In this manner, hazards that have higher risks need to be given priority.

6.3.2 Risk assessment should provide information on:

- Where and how many employees are likely to be at risk of incurring injuries;
- The likelihood – or the probability that - this is likely to occur, taking into consideration the existing control measures; and
- The potential severity of any injuries. As severity refers to the intrinsic or inherent nature of the adverse effect(s) that may result from the hazard, the existing control measures must not be taken into consideration when assessing severity.

6.3.3 When the risks have been assessed, reasonably practicable measures must be taken to reduce or maintain the risk level at an acceptable level. It is important that no work must be allowed to commence if the risks are assessed to be high or unacceptable.

6.3.4 The results of the risk assessment must be approved and endorsed by the top management. The control measures should as far as practicable, be implemented within the shortest timeframe. In determining the implementation of the control measures, priority must be given to those in higher risk level.

6.3.5 An action plan should be prepared to implement the control measures. The plan should include a time line of implementation and responsibility of persons implementing the safety and health control measures. The plan should be monitored regularly until all the measures are implemented.

6.3.6 Organisations may opt to undertake a generic assessment to be used for similar work activities in different workplaces. If such a model is used, it is necessary to ensure that the risk assessment must be validated to be relevant and applicable for the particular workplace and the work processes.

7. Risk Control Measures

7.1 Hierarchy of Control

7.1.1 If workplace safety and health risks exist, the employer, self employed person or principal shall, as far as reasonably practicable, put measures in place to control those risks.

7.1.2 The appropriate control measures/methods selected to reduce or maintain the risk of falling from heights shall be carefully assessed and implemented to ensure its effectiveness.

7.1.3 The approaches below are listed according to a hierarchy of control as shown in Fig 7.1. The approach to control measures should be attempted from the top of the hierarchy onwards. These controls are usually not mutually exclusive e.g. engineering controls can be implemented concurrently with administrative controls.

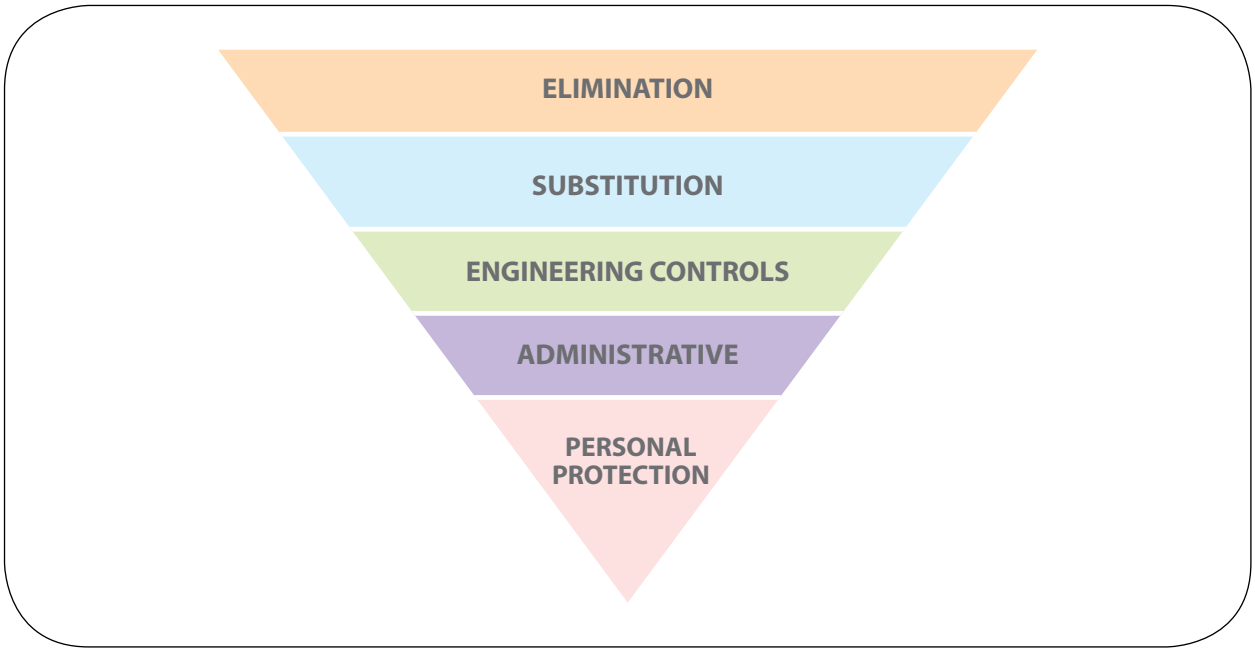

Figure 7.1: Hierarchy of Control.

7.2 Elimination

7.2.1 Elimination of hazards refers to the total removal of the hazards and hence effectively making all the identified possible accidents and ill health impossible.

7.2.2 This is a permanent solution and shall be attempted in the first instance. If the hazard is removed, all the other controls, such as the use of fall protection system, workplace monitoring and surveillance would no longer be required. In effect, the item is removed from the table of hazards.

7.2.3 Examples of elimination include:

- Prefabricating wall frames horizontally before standing them up;
- Using precast tilt-up concrete construction instead of concrete walls constructed in situ; and
- Using paint rollers with extendable handles rather than working on a ladder.

7.3 Substitution

7.3.1 This involves replacing the hazard by one that presents a lower risk. For example, by using mobile elevated work platform (MEWP) instead of ladders for reaching high places. The risk level is lowered as MEWP generally provides a higher level of fall protection than ladders.

7.4 Engineering Control

7.4.1 Engineering controls are physical means that limit the hazard. These include structural changes to the work environment or work processes or erecting barriers to prevent the worker from being exposed to the hazard.

7.4.2 An example of an engineering control includes edge protection such as using guard-rails at open sides to prevent persons from falling over.

7.5 Administrative Controls

7.5.1 Administrative controls are systems of work or work procedures that help to reduce the exposure of workers to the risks of falling. It is also a useful means to limit the frequency and duration of exposure of workers to hazards and the number of persons involved in the task.

7.5.2 Administrative controls may also be used to support or be used in conjunction with other control measures that are put in place. For example, safe work procedures may be needed to guide workers on the safe use of temporary work platforms, which in itself is a form of engineering control measure.

7.5.3 The development of administrative controls should also involve people who perform task regularly, such as contractors and workers as they often have a good understanding of the risks involved.

7.5.4 For effective use of administrative controls, it is necessary to ensure that information is adequately and effectively communicated to the workers. For example, daily toolbox meetings may be used for such purposes.

Prohibition of Access

- Marking out an area can be effective in making sure that people are not exposed to fall hazards. There should be adequate signages to warn against access to the hazardous area. If possible, a physical barrier should be erected to prevent unauthorised access.
- Employers should provide relevant information to employees on site and adequate supervision to ensure that no worker enters a “No Entry” area.

7.6 Safe Work Procedures

7.6.1 Safe Work Procedures (SWPs) are the most common form of administrative controls in workplaces. It is a set of systematic instructions on how work can be carried out safely. Using information obtained from risk assessment, a set of SWPs should be developed for various work activites that have a risk of falls from height.

7.6.2 The SWP generally provides instructions on how jobs are to be performed, persons involved in these jobs, what safety precautions must be taken and what kind of training and/or certification is necessary to be able to competently carry out these jobs.

7.6.3 The SWP must be communicated to everyone involved in the job so that each person is aware of his roles and responsibilities. The SWP must also be communicated to those who will be affected by the job.

7.6.4 It is necessary to provide adequate level of supervision to ensure that the safe work procedures are being followed. Regular review of the effectiveness of the procedures must be undertaken.

7.6.5 Make sure that the work is well organised so that workers do not increase the risk of a fall for themselves or others. For example, sequence jobs so that different trades are not working above or below each other at the same time.

7.7 Use of Personal Protective Equipment

7.7.1 Personal protective equipment (PPE) should be used only as a last resort, after all other control measures have been considered, or as a short term contingency during maintenance/repair, or as an additional protective measure.

7.7.2 The effectiveness of PPE as a control measure is dependent on the correct equipment being chosen, fitted and worn properly at all times when required by users.

7.7.3 PPE should be selected taking into consideration the following factors:

- The type of hazard;
- Areas of the body that require protection;
- The degree of protection required;
- Ease of use, comfort and convenience;
- Reliability; and
- Ease of maintenance.

7.8 Ensuring Control Measures are Safe and Do Not Introduce New Risks

7.8.1 It is important that the control measures selected do not introduce new hazards or expose workers who are installing, erecting or removing these control measures (such as scaffolding) to a greater risk than the one it is designed to control.

7.9 Maintaining and Re-evaluation of Controls

7.9.1 The control measures implemented must be regularly monitored and reviewed to ensure that they are effective and are in good working condition.

8. Inspection and Maintenance

8.1 A thorough visual inspection and checks on equipment usage is important for ensuring that the equipment is free from observable defects. Equipment that have exceeded their serviceable life span or passed their expiry date should not be used.

8.2 A maintenance programme should be established and implemented to periodically inspect and maintain both operational and safety equipment in good working condition.

8.3 The maintenance programme shall include the following components:

- An inventory of equipment that require regular maintenance;
- Frequency of inspection and maintenance;
- Procedures of inspection and maintenance;
- Preventive maintenance, such as servicing;
- Repair for damaged items;
- Replacement for irreparable items; and
- Record keeping (such as for damages, flaws detected, any preventive maintenance, repairs or replacements done).

8.4 Maintenance of equipment should only be performed by trained and competent persons.

9. Instruction and Training

9.1 Information, Instruction and Training

9.1.1 Persons working at height who are exposed to the risk of falling should be provided with sufficient and adequate information, instruction and training so that they have the skill and knowledge to perform the work safely. It should help them understand:

- The nature of fall hazards to which they are exposed;
- The risk of injury associated with the task;
- The control measures that are needed, including safe work procedures and the use of personal protective equipment;
- The proper usage and maintenance of equipment, such as performing inspection to ensure equipment are in good condition before use;
- Procedures to follow in the event of an emergency such as rescue, accident, or injury.

9.1.2 The amount of information and type of training depend on several factors such as the risks involved, the level of operator skill required and the complexity of the tasks and work procedures. Some common forms of training include:

- General induction course for new workers;
- 'In house' training programmes; and
- Formal training courses offered by accredited training providers.

Information can be disseminated during:

- "Toolbox" briefing
- "On-the-job" training;

9.1.3 Information should be provided in a form that can be understood by all workers. This may include providing information in languages other than English.

9.1.4 If classroom teaching is conducted, it should be complemented by hands-on training to provide practical experience.

9.1.5 Induction programmes are essential and should be provided for workers taking up new jobs or where work situations have changed. Records of training should be kept to enable on-going programme evaluation and review.

Key Elements of an Effective Training Programme

In developing and implementing an effective programme, employers should consider the following:

- An analysis of training needs, including the identification of the tasks to be performed and any associated hazards and risks;
- Identification of any pre-requisites or entry standards;
- Definition of learning objectives and clear identification of the extent/level of competencies to be achieved;
- Selection of appropriate training methods and aids depending on the topic, environment and targeted trainees;
- Adequate assessment to ascertain that the trainees understand and have acquired the knowledge and skills and demonstrated the necessary level of competency;
- Recognition of skills attained where applicable (e.g. accreditation or certification);
- Delivery of training by a competent person; and
- Evaluation of effectiveness of training.

Training on Individual Fall Arrest Systems

An individual fall arrest system requires moderate level of competency on the part of the user to ensure that it is used properly. Employees who use these systems should be trained in the correct fitting, anchorage, use and maintenance of the individual fall arrest systems. It is also important for the users to understand fall hazards and the risks of injury associated with the tasks that they are undertaking. The training should also include how to respond in an emergency.

10. Accident/Incident Investigation

10.1 All accidents or incidents relating to falls from height should be investigated and analysed for the following objectives:

- Determine any underlying deficiencies in the existing fall protection system and plan, which might have contributed to the occurrence of the incident;
- Identify the need for corrective action to be taken to address any such deficiencies as identified; and
- Identify the opportunities for preventive actions to be taken to prevent any such incident from recurring.

10.2 The results from any such incident investigated (inclusive of lesson learnt and the corrective/preventive actions to be taken) should be promptly communicated to all relevant parties.

10.3 A record of all accidents and incidents and their investigation findings and outcomes should be properly documented.

11. Emergency Response

11.1 Emergency Planning

11.1.1 A written emergency response plan must be established.

11.1.2 Emergency response equipment must be kept on site and made readily available and accessible.

11.1.3 As rescue operations are often carried out under extreme pressure, consideration should be given to all aspects of the rescue process. Elements to consider should include the type of:

- Rescue method;
- Equipment required;
- Procedures to gain access into less accessible areas; and
- The training required for rescuers.

11.1.4 Emergency responders or rescuers should be appointed and adequately trained to carry out rescue operations. Arrangement should be made such that a sufficient number of emergency responders are available at every work shift.

11.1.5 Workers must be provided with information on the emergency plan including:

- Who to approach or call in the event of an emergency;
- The procedures to follow for emergencies, including those for persons suspended in safety harnesses during fall arrest. It is recommended that training in self-rescue techniques be provided for workers using safety harnesses; and
- Assembly point (if relevant).

11.1.6 The provision of first aid treatment and first aid facilities should be considered. Persons assigned to first aid duties must be competently trained.

11.2 Rescue Operations - Fall Arrest Systems

11.2.1 The immediate rescue of a person after an arrested fall can prevent the onset of injuries such as suspension trauma which can occur when a person is suspended in a harness over a period of time.

11.2.1 Emergency plans and rescue procedures to recover persons suspended in safety harness should consider the following:

- The type of equipment required to carry out a rescue. Such equipment must be suitable for use in all foreseeable situations in the workplace. Existing equipment such as mobile elevated work platforms and scissor lifts may be used for conducting rescue if suitable.
- The installation of individual fall arrest systems and individual rope access systems should be at locations where it is possible to assist or rescue a person quickly if required;
- Ensure that all workers using fall arrest systems are familiar with devices before the commencement of work;

- Make provision for access to first aid facilities or services, including trained first aiders. The rescue team should include a person or people trained in the provision of first aid so that it can be administered to the fall victim in the event of an injury occurring during a fall;
- The details of additional support facilities, including the location, contact information and availability of emergency services, such as Singapore Civil Defence Force (SCDF), ambulance and hospitals; and
- An effective and readily available means of communication.

Precautions on Suspension Trauma

- Suspension trauma may occur when a person has an arrested fall and is suspended in an upright position. When the legs are dangling in mid-air without support for a period of time, blood is not naturally moved out of the legs and back into the heart. This could result in fainting, or loss of consciousness within minutes and may eventually lead to death. Depending on a person's susceptibility, the condition may be worsened by heat and dehydration. Therefore the quick rescue of a person suspended in a full body harness as soon as possible is vital.
- The rescued victim of fall arrest must not be positioned in or allowed to take up a horizontal position immediately after reaching a safe resting place. The person must be placed with the legs horizontal and the torso vertical or steeply inclined. Sufficient time must be allowed for the person to recover from suspension trauma and acquire normal blood circulation and pressure, before allowing the victim to lie down.

12. Supervision

12.1 A competent person should be appointed to provide proper and adequate supervision for workers to ensure that they are not exposed to hazards and all reasonable precautions have been taken where there is a risk of falling.

12.2 Supervision is especially important if the workers are undergoing training, or are new or inexperienced and unfamiliar with the working environment.

12.3 It is essential that persons performing supervisory roles must be competent and have the skills and knowledge of the work processes that they are to supervise.

12.4 Persons performing supervision roles must ensure that:

- Required safety measures are in place before the commencement of the work;
- Workers are adequately supervised, particularly when working in an elevated position; and
- Only workers who have received appropriate training and instruction in relation to the tasks they are to perform are to carry out the work.

Section B: Fall Control Measures

13. Access to and Egress from Work Areas

13.1 Access and Egress Risk and Assessment

13.1.1 Employers are to provide a safe means for people to get to and move around the work area. The planning for the provision of suitable access and egress should take into account the tools and equipment that people will be required to carry.

13.2 Access and Egress Safety Considerations

13.2.1 In providing safe and proper access to, egress from a work area, the following should be considered:

- Installation of fixed work platforms, walkways and stairways;
- Use of temporary work platforms such as scaffolds and crawl boards;
- Installation of fall arrest systems;
- Frequency and number of people who may need access to or egress from the work area. Supervision and regular inspection should also be considered;
- Provision of safe work surfaces;
- Method of getting equipment and materials to the work area;
- Exposure of access ways to the weather (for example, rain can make surfaces slippery and strong winds can cause loss of hand grip);
- Provision of adequate natural or artificial lighting to all access ways;
- The clearance of obstructions so that persons are able to move easily to and from the workplace; and
- Location and space required for any equipment or materials used or being temporarily stored.

Housekeeping and Material Storage

The risk of falls due to tripping and slipping can be reduced by proper planning for material storage and good housekeeping. Such good practices not only result in a cleaner and safer workplace, it can also improve productivity.

13.3 Roof Access

13.3.1 Employers and occupiers should provide their workers with a safe means of getting to and from the roof. The access ways need to be in place before commencing work. Access should be located where the work on the roof is to begin.

For new roof installations or where extensive repair or replacement of existing roofs is planned, it is recommended that a ladder access tower or a personnel and materials hoist be provided.

13.3.2 After a roof membrane has been installed, special provisions may need to be made if the roof is to be used as a platform for access, egress, work or storage. If access and egress is required regularly, a permanent system such as stairs may need to be installed. Stairs should serve each floor of a building or structure that is being constructed or demolished.

13.4 Guarding of Openings

13.4.1 Openings on floors or platforms present significant hazards. A person may fall through an opening, which may result in serious injury or death. If the opening that is stepped upon is small, cuts and bruises may result on the legs or feet. (Fig 13.1, left).

13.4.2 A person may fall through or step into openings such as lift openings and stairwells. A barrier should be erected around the opening to prevent persons from falling. In addition, the opening should be guarded with embedded wire mesh and covered with material of adequate strength to prevent entry by objects or persons. The cover should be secured to prevent it from dislodging.

13.4.3 When a opening is protected by a cover, a suitable signage such as that shown in Fig 13.1 (right diagram) should be placed nearby or onto the cover itself to warn people of the hazard.

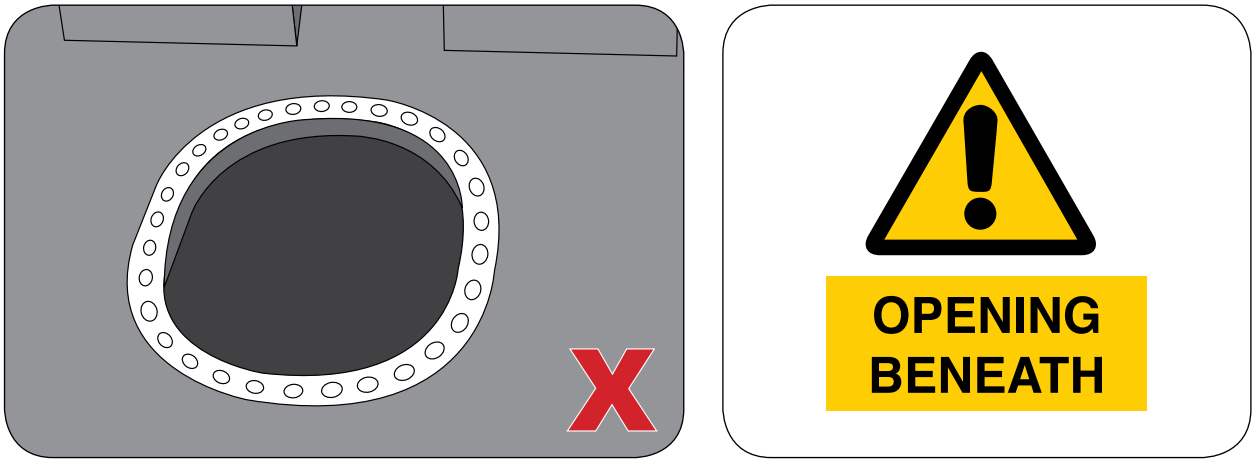

Figure 13.1: Left, unprotected openings are severe hazards and must be covered. Right, a warning sign, it can be placed nearby the opening or affixed to the opening cover itself.

14. Edge Protection

14.1 Perimeter Guard-Railing

14.1.1 Edge protection (often referred to as a 'guard-rail') is used to reduce the risk of a person falling from open sides (Fig 14.1).

14.1.2 Edge protection must be provided to the edge of a scaffold, walkway, ramp (Fig 14.2 and Fig 14.3), and landing or wherever a person is at risk of falling from open sides. The protection must also be able to withstand the impact of a person falling against it.

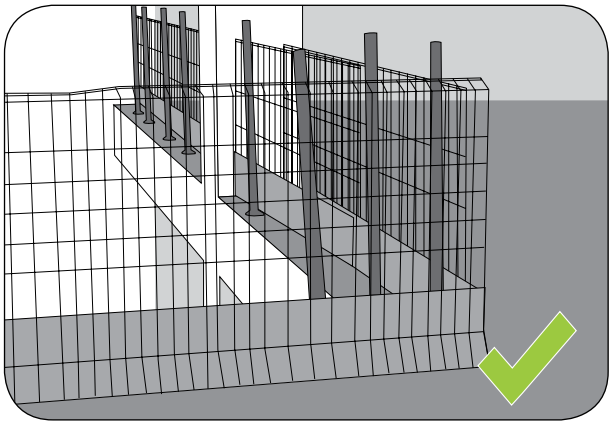

Figure 14.1: Perimeter guard-railing.

Figure 14.2: Unprotected stairways pose a falling hazard.

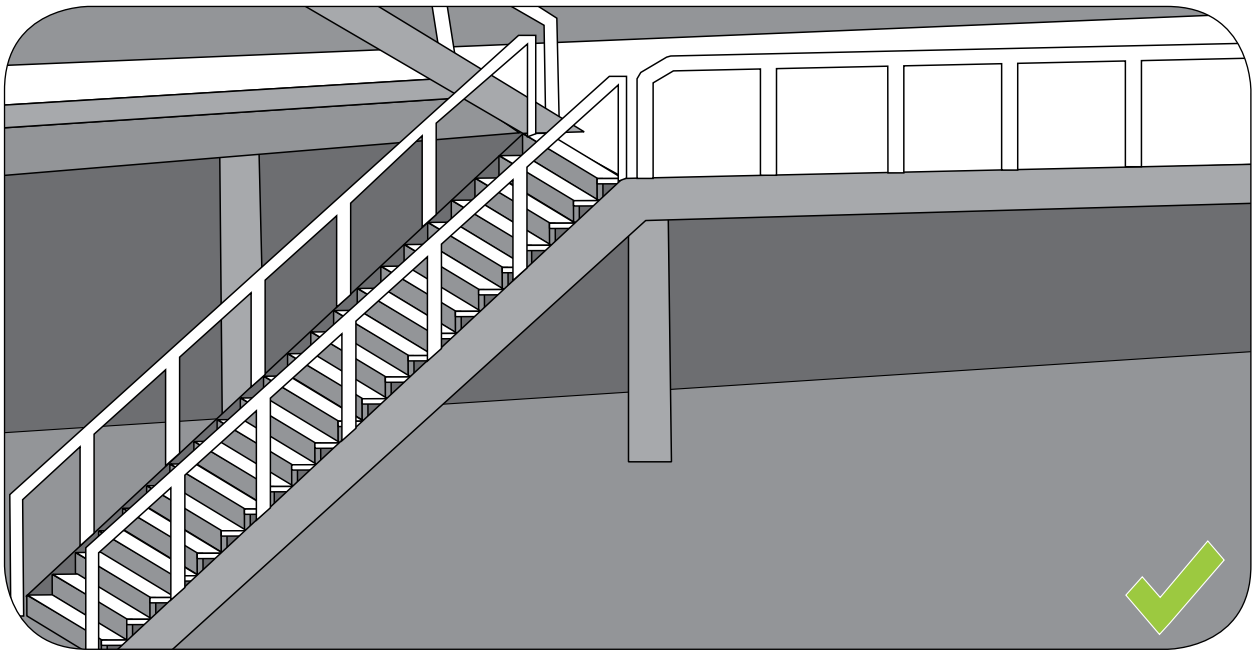

Figure 14.3: Stairways fitted with handrails.

14.1.3 Edge protection must also be provided at any other edge at the workplace where a person could fall. Such protection must adhere to the set requirements listed below.

- Temporary or advance guards must be provided to reduce the risk of a scaffold erector falling from the uppermost, unsecured or exposed scaffolding level during the process of erecting or dismantling scaffold;
- The guard-rail system must be of sound construction and be able to withstand the weight of a person applied at any point;
- Toprails must be at least 1m above the working surface;
- Midrails and toe-boards must be provided. However, wire mesh infill panels incorporating a toe-board may be used instead of the midrails;
- A bottom rail above the toe-board on some roof slopes may be provided for more severe roof slopes. Both a midrail and infill mesh panel will assist in preventing persons and objects from sliding off the roof;
- If access points are required for equipment (for example, a hoist), they should be protected adequately with gates, safety chains or any other means to prevent a person falling. The access points must always be covered when not in use;
- Where guard-rail systems are intended to be used in conjunction with steel structures or tilt-up construction, designers and builders should plan for the guard-rails and fixings to be attached to the panels prior to the structures being raised from the edge protection that is being used. This is in order to reduce the risk of a person falling from one level to another.
- Scaffold may be used as fall protection around the edge of the roof by incorporating guard-railing as edge protection into the scaffold.

15. Fall Protection Systems

15.1 Scaffolds

15.1.1 Scaffolds are any temporary structures:

- On and from which a person performs work in any workplace; or
- Which enable a person to access the location to perform work; or
- Which enable materials to be taken to any place at which work is being performed.

15.1.2 All scaffolds and its components must meet the requirements of the regulations stipulated in the Factories (Scaffolds) Regulations. See Fig 15.1 for the basic components of a scaffold.

15.1.3 If a scaffold exceeds 4m, it must be erected by an approved scaffold contractor.

15.1.4 The design of a professional engineer is necessary for scaffolds with the following conditions:

- For construction sites and general factories, construction of any metal scaffolds exceeding 30m in height and/or with cantilever or jib support;
- For shipyards, construction of metal scaffolds exceeding 15m in height.

15.1.5 In addition, all hanging scaffolds, from which a person may fall more than 2m must also be constructed and installed in accordance with the design and drawings of a professional engineer.

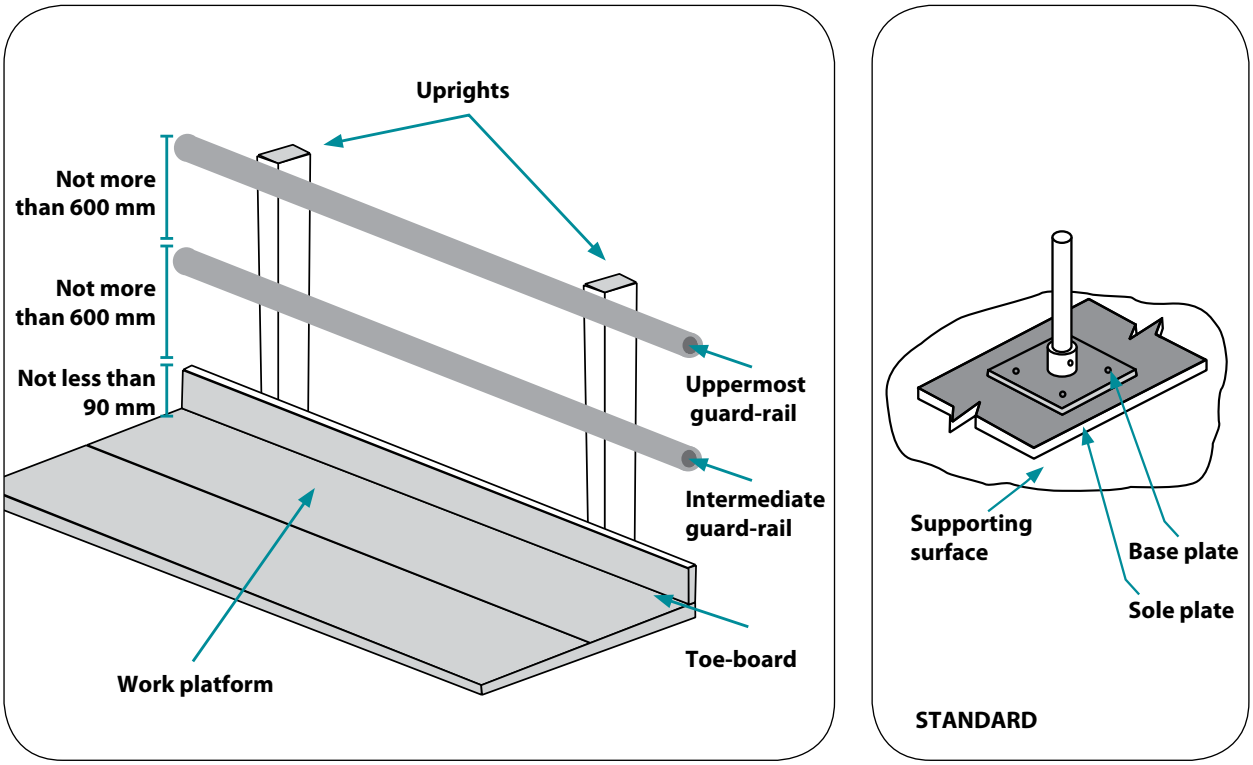

Figure 15.1: **Scaffold, with components labelled.**

15.2 Tower Scaffolds

15.2.1 Tower scaffolds are a particular form of scaffolding that usually consist of fabricated frame units constructed as single-bay towers. Most available tower systems are aluminium, but steel systems are also available. A tower scaffold that is fitted with castor wheels equipped with effective locking devices is deemed to be a mobile tower scaffold (Fig. 15.2).

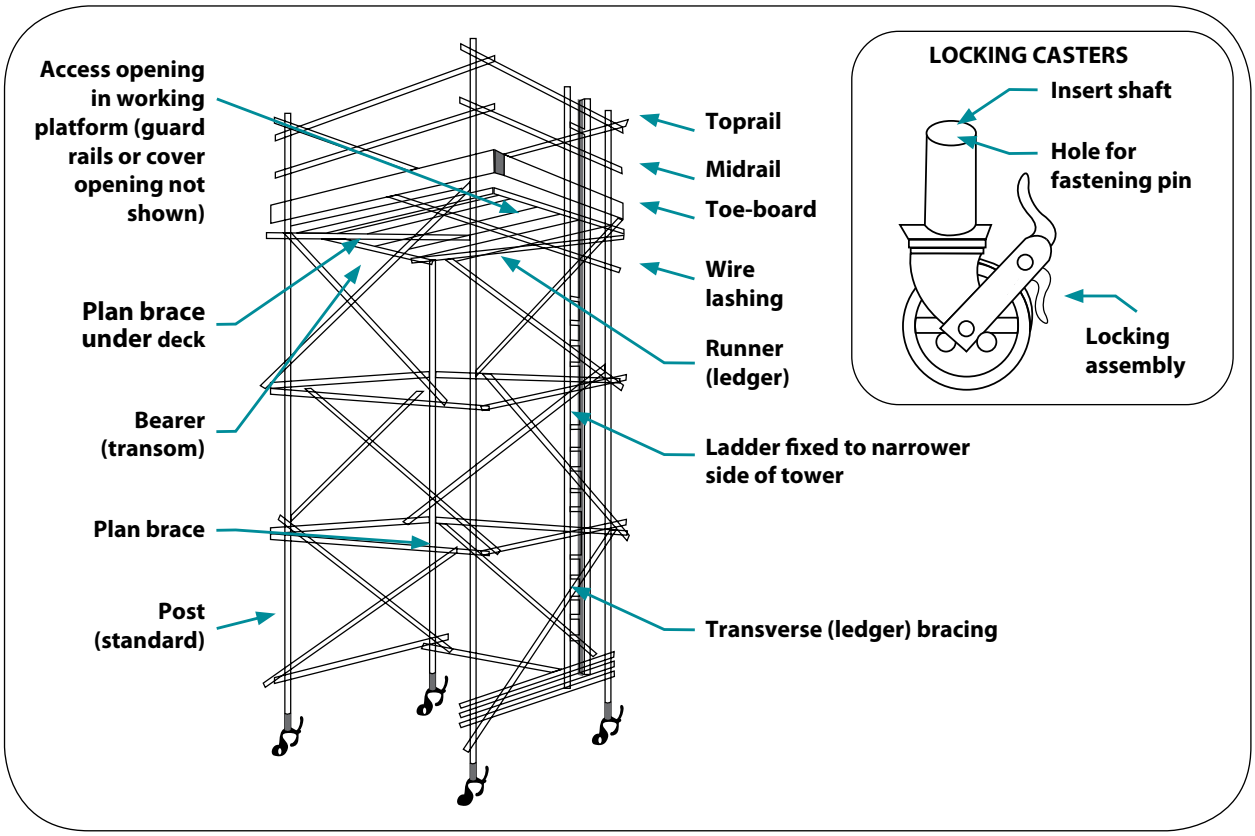

Figure 15.2: A mobile scaffold with access ladder, opening and other features to provide a hazard-free working platform.

15.2.2 A tower scaffold should be erected by a competent person.

15.2.3 Edge protection such as guard-rails must be provided at the highest landing.

15.2.4 When a tower scaffold is mounted on castors for use as a mobile scaffold, the following rules should be strictly observed:

- Tower scaffolds should be moved with caution;
- Prior to moving, the route must be checked for power lines, overhead obstructions and for holes and uneven surfaces on the ground;
- When it is necessary to deploy tower scaffolds on an inclined surface, measures must be taken to ensure stability, such as the use of outriggers. Otherwise, tower scaffolds should not be deployed on an inclined surface.
- Never access the scaffold until all its castors are locked to prevent movement;
- Never shift or move the scaffold while anyone is on it;

- Do not cover the scaffold with containment sheeting such as shade cloth, unless it has been specifically designed for the purpose and it is only used in an enclosed, wind-protected environment;
- Tower scaffolds must be inspected by a competent person before its first use:
  - After substantial alteration;
  - After any event likely to have affected its stability; or
  - Once it has been in place for 7 days.

  At intervals not exceeding 7 days, tower scaffolds must be inspected and a written report made.

15.3 Mobile Elevated Work Platforms/Hoists

15.3.1 A mobile elevated work platform is any telescoping, scissor or articulating equipment used to position personnel, materials or equipment at height.

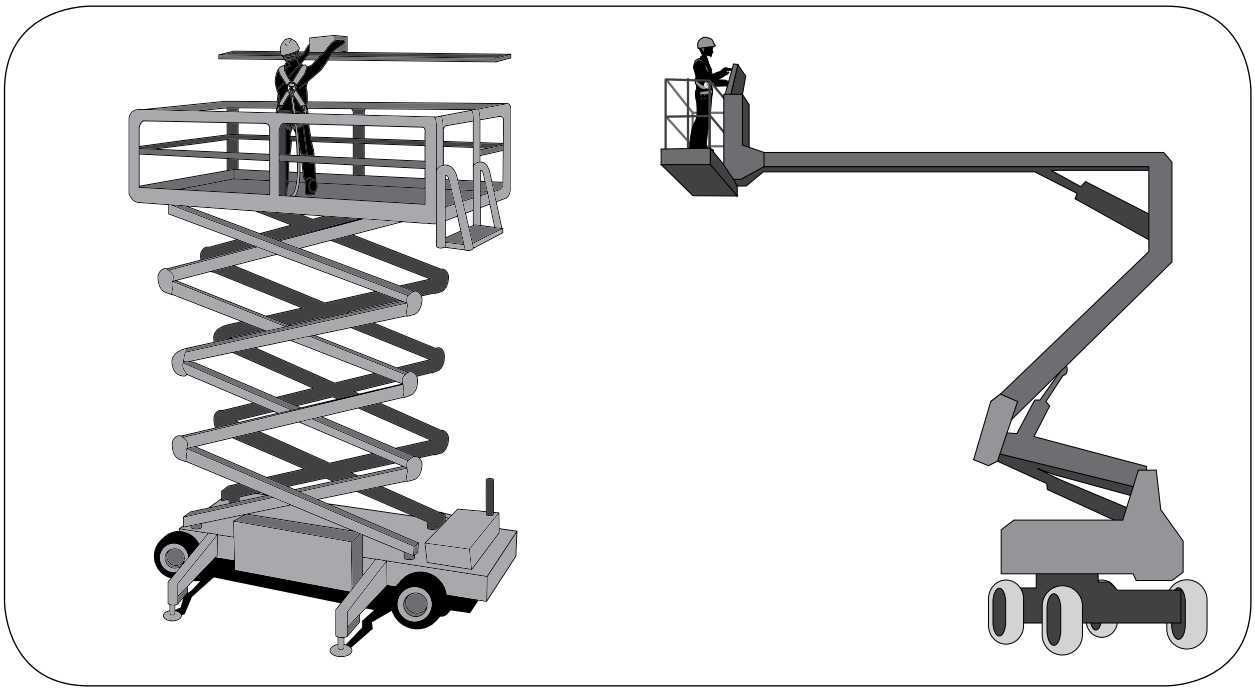

Figure 15.3: Examples of mobile elevated work platform; scissor lift (left) boom arm platform (right).

15.3.2 Mobile elevated work platforms consist of a platform surrounded by an edge protection system. The protected platform is used to position persons at work areas. Mobile elevated work platforms are available in a wide variety of types and sizes. They include scissor lifts and boom lifts (Fig 15.3).

15.3.3 There are battery powered and internal combustion engine types. Some are designed for hard flat surfaces only, while others are designed for operation on rough terrain.

15.3.4 Mobile elevated work platforms:

- Should only be used on a solid level surface. The surface area should be checked to make sure that there are no penetrations or obstructions that can cause uncontrolled movement or the platform to overturn;
- Should be clearly marked with a safe working load limit or maximum rate capacity notice; and
- Should not be used in high wind conditions or where there is risk of lightning.

15.3.5 The following requirements are needed to provide for the safe use of mobile elevated work platforms:

- Operators of boom lifts should be properly trained and competent for the job. The level of training must be such that the operator is competent to carry out a visual inspection as well as the functional tests of the mobile elevated work platform. The ability to perform an adequate risk assessment is also vital for operators. They should also be familiarised with the mobile elevated work platform to understand if the unit requires any specific precautions such as the need to deploy outriggers.
- A risk assessment of the work and the area must be done by the operator before commencing any work. This is to identify any unsafe conditions of the workplace or the need to implement any additional control measures.
- A pre-operation inspection must be performed by the operator before usage. The inspection must include functional tests to determine if the mobile elevated work platform is in proper working condition.
- There must be no unauthorised alteration or modification of the mobile elevated work platform or any of its safety devices or functions.
- It is recommended that the load pressure at the contact points of the mobile elevated work platform with the ground be marked near the contact points. This is to help in preventing accidental positioning of the work platform on surfaces which may not be able to sustain the weight of the work platform.
- The operator must be able to recognise conditions such as hazardous terrain, such as slopes or trenches. They can result in work platforms tipping or falling over when moving over such terrain, resulting in the possibility of the operator being thrown off the work platform.
- Operators working in boom lifts should wear a suitably anchored safety harness. Anchoring to nearby poles or equipment outside the work platform is prohibited.

15.3.6 Personnel required to climb out of an elevated boom lift onto an elevated facility structure shall utilise 100 percent tie-off procedures (refer to paragraph 17.2) during the transition from the boom lift cage to the elevated work location, (i.e. personnel must anchor to a fall rated facility anchorage point prior to disconnecting their lanyard attached to the aerial boom lift cage).

15.3.7 The use of planks, ladders or any other devices on the work platforms for the purpose of achieving additional height or reach is strictly prohibited.

15.3.8 Always refer to the operator's or service manual for additional fall protection requirements for specific lift equipment.

15.4 Suspended Gondola

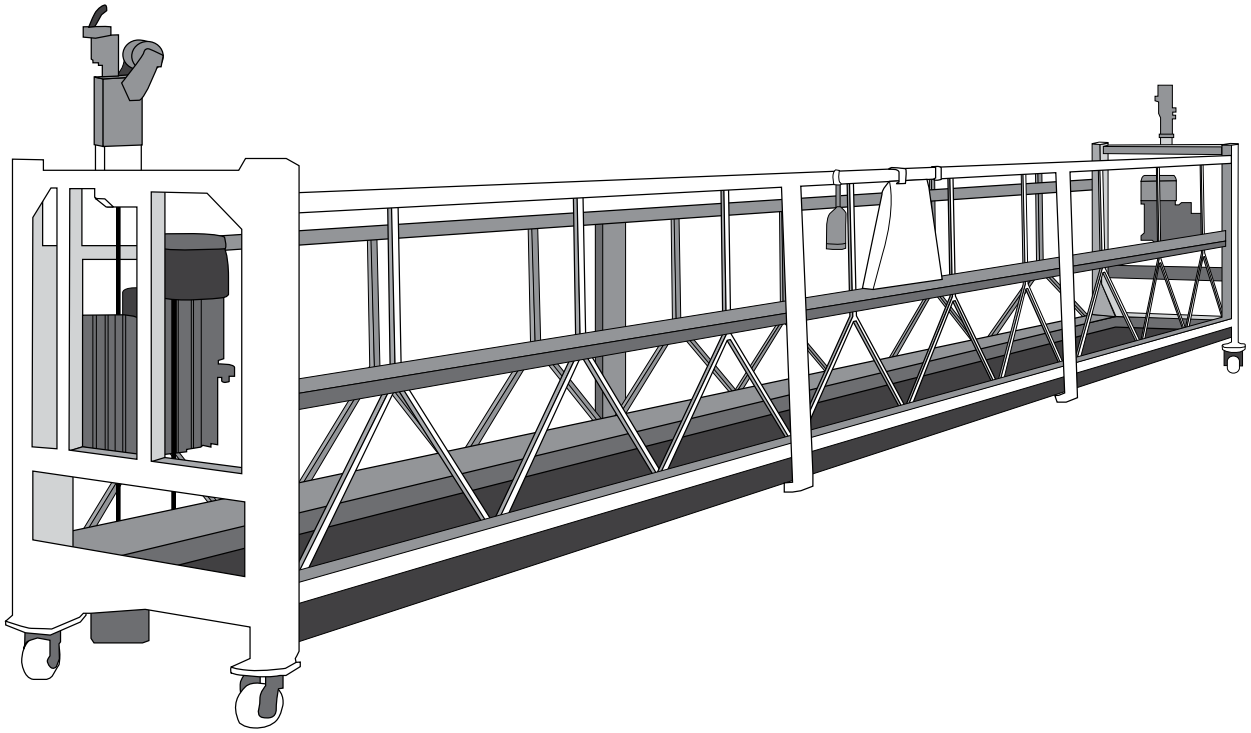

Figure 15.4: A gondola is mainly used for performing work on the sides of buildings.

15.4.1 A suspended gondola (Fig 15.4) is a power-operated suspended working platform that is fixed to a building structure. It is used for access during building maintenance or window cleaning.

15.4.2 During the planning stage, consideration should be given to the methods by which maintenance, repairs or cleaning will be undertaken on buildings or structures.

15.4.3 Consideration of future maintenance requirements in the early design stage will avoid the possibility of unsafe work practices occurring during routine maintenance. Sloping building exteriors and recline windows require priority consideration to ensure that maintenance can be carried out in a safe manner.

15.5 Mast Climbing Work Platforms

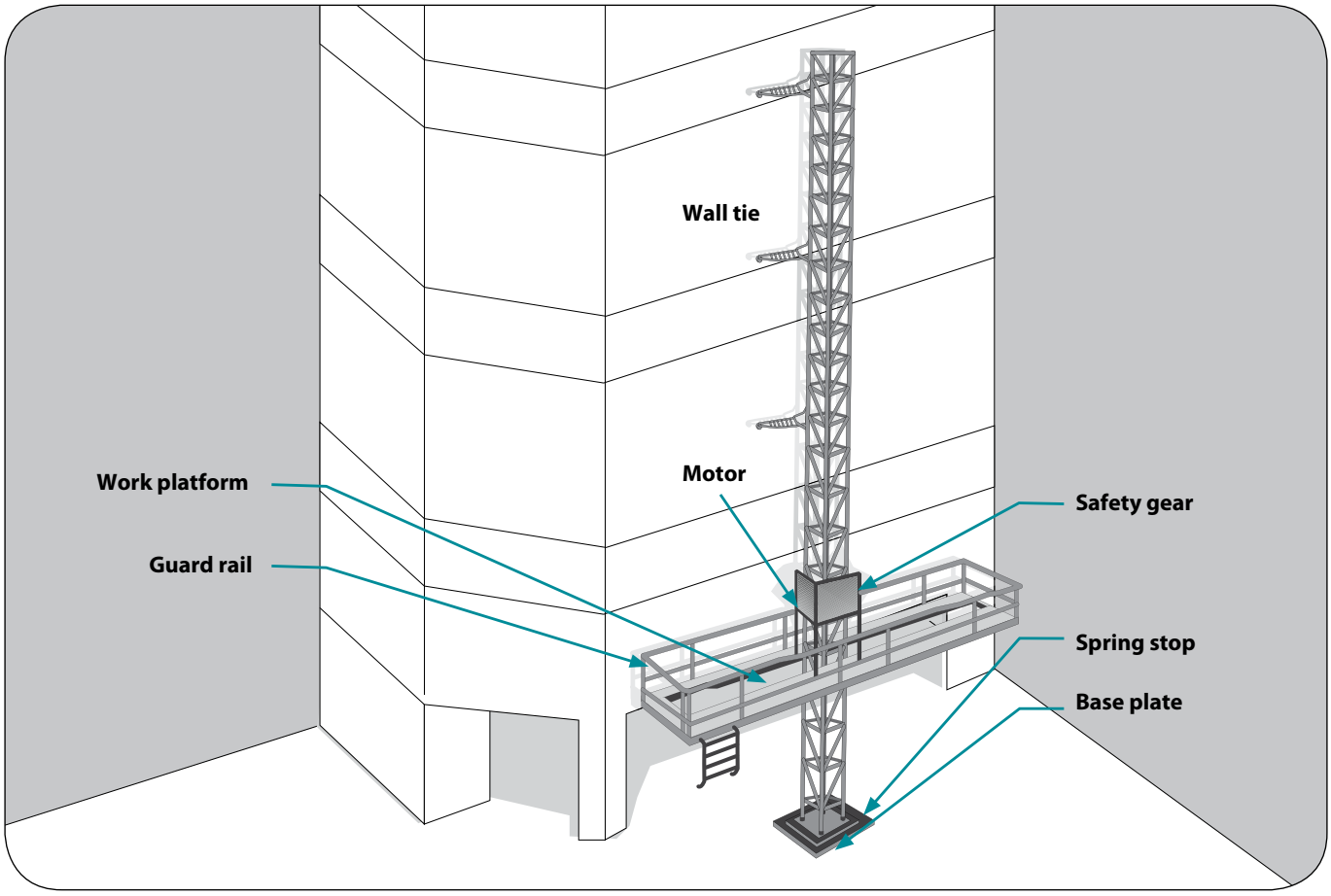

Figure 15.5: A mast climbing work platform is used to raise personnel and materials to the working position.

15.5.1 Mast climbing work platforms (Fig 15.5) are hoists that have a working platform used for temporary purposes to raise personnel and materials to the working position.

15.5.2 Mast climbing platforms are generally not suitable for use where the profile of a structure changes at different elevations, for example where upper floors of a building "step" back or balconies protrude from the building.

15.5.3 The erection and rigging of mast climbing work platforms should be carried out or directly supervised by a competent person.

15.5.4 Items transported inside the mast climbing work platform must not protrude out from the machine, they may fall out if caught on external objects.

15.5.5 Operators working in mast climbing work platforms should wear an anchored safety harness.

16. Individual Fall Prevention Systems

Fall Prevention and Fall Protection Systems

1. Fall prevention systems

(a) Individual/Active:

(i) Work restraint: A fall prevention system which relies on waist belt or body harness and fixed length lanyard connected to a suitable anchor, so as to restrain the person from getting to the place where they could fall.

(ii) Work positioning: A personal fall prevention system which includes a harness connected to a reliable anchor point to support the user in tension or suspension in such a way that a fall is prevented or restricted. All work positioning systems must be provided with a back up system in case the primary support fails.

(b) Collective/Passive: Guard-rails and other physical barriers with warning signs at the edges of the safe work zone.

2. Fall arrest systems

Individual/Active: A fall protection system that uses a harness connected to a reliable anchor to arrest and restricts the fall and prevents the user from hitting the ground. It usually has an energy absorbing device to limit the impact of gravity forces on the body.

16.1 Industrial Rope Access Systems

16.1.1 Industrial rope access systems (Fig 16.1) are used for gaining access to work areas that are hard to reach by other means, usually through the use of vertically suspended ropes. Rope access systems require a high level of competency from the users and therefore, other means such as mobile elevated work platforms and suspended gondolas, which require less skill to operate, should be used if it is reasonably practicable to do so.

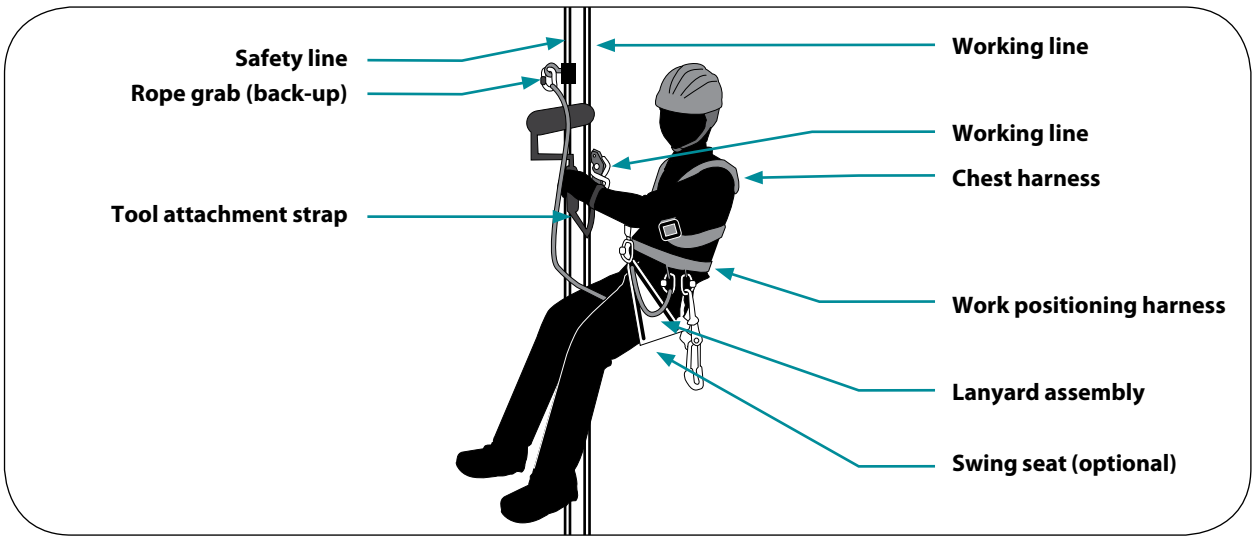

Figure 16.1: Operator using an industrial rope access system, the backup device is to be maintained at a higher elevation in relation to the operator.

16.1.2 Industrial rope access systems are a specialised and job specific form of abseiling. The system is designed to access areas for work such as window cleaning, sign maintenance on high rise buildings and other forms of maintenance where it is not reasonably practicable to use other forms of access. Such systems are usually suited for light or medium work but may be adapted for heavier work, such as derrick erection in shipyards through the use of lightweight gondolas for firmer footing.

16.1.3 Industrial rope access systems require a high level of competency on the part of the user to ensure safe use. An industrial rope access system can be extremely dangerous if used by an inexperienced or untrained user.

16.1.4 The critical items specific to safe usage of industrial rope access systems include the following:

- **Training** – Due to the high level of skill and competency required for the safe usage of industrial rope access systems, operators must be provided with a structured and documented syllabus. Minimally, workers must be capable of conducting self-rescue. A rope access supervisor must be a trained and competent rope access operator who has sufficient experience in performing work using rope access and had undergone advanced training and assessment. This is to ensure that the rope access supervisor has the experience and skills needed to supervise rope access operators and their abilities to work safely.
- **Team size** - The team should have a minimum of 2 operators, one of whom must be a trained and competent rope access supervisor – due to the potential hazards of using industrial rope access systems, no operator must be allowed to work alone. In addition the supervisor's role is also to oversee and guide the team. The supervisor must also be well-versed and trained in rescue techniques, able to direct rescue if the necessity arises.
- **Adequate rest periods** – The amount of fatigue and productivity of workers is affected by factors such as weather conditions and the difficulty of the position at which work is carried out. A significant factor is the altitude; work at high altitude exposes workers to higher wind speeds and low temperature. Other factors to consider include weather conditions and the type of work carried out.
- **Selection of workers** – Workers engaged in such tasks must have the correct attitude and aptitude for work at height as they will need to be relied upon to behave in a sensible, responsible manner during work. Operators should be physically fit and free from any disabilities that may prevent them from working safely.
- **Selection of equipment** – The equipment used can be determined through the risk assessment process, which must be carried out before each job. The equipment must be compatible, i.e. the safe function of any equipment or component must not affect or interfere with the safe function of another. Equipment that is safe for use in conventional situations may present risks to operators using industrial rope access systems. The manufacturer of the equipment should be consulted to clear any ambiguity or doubt.
- **Use of tools** – The greatest danger, in many cases, is that of tools falling onto people below. Hence, small tools should be secured to the operator by lanyards. Small items can be carried in buckets or bags fastened to the worker. It is important to note that the combined weight of all the items carried must be within the safety factor of the system.
- **Traceability of equipment** – Equipment that is withdrawn from service must not be used without the inspection and approval of a competent person. Defective equipment should be cut up or broken before disposal to prevent unauthorised retrieval and misuse.
- **Storage of equipment** – After usage, equipment should be cleaned and dried. Equipment should be stored unpacked in a cool, dark, dry location that is chemically neutral. Items that may damage the equipment, such as sharp objects or corrosive substances must not be stored in close proximity to the equipment. If the equipment has been used in a marine environment, they must be rinsed thoroughly in clean fresh water, dried and inspected before storage.

16.1.5 Where it is necessary for industrial rope access systems to be used:

- Workers must be trained and possess a high level of competency;
- Workers must be adequately supervised by a trained and competent rope access supervisor;
- All workers should wear a sit harness with a separate chest harness and the worker should be attached at the central waist (ventral) point. The above procedures when combined will provide fall arrest capabilities. The following British Standards may be consulted for details pertaining to such equipment:
  - Sit harness – BS EN 813;
  - Chest harness – BS EN 12277;
  - Combination of sit harness and chest harness – BS EN 361.
- Supervisors should ensure communication between personnel is sufficient for the task;
- Procedures should be clearly understood by the worker;
- Two independently anchored ropes should be used for each person;
- Any person within 2m of an unguarded edge should be adequately secured;
- Workers must not work alone in case assistance is required in an emergency;
- Barricades and signposts should be placed on all access points to the base and anchorage locations (for both public and workers);
- Industrial rope access systems should only be installed in a location where it is possible to provide prompt assistance or rescue when necessary; and
- An industrial rope access system is NOT designed to stop or sustain falls unless combined with a fall arrest lanyard.

16.2 Travel Restraint Systems

16.2.2 A travel restraint system is a system that:

- Consists of a safety harness or belt, attached to one or more lanyards, each of which is attached to a static line or anchorage point; and
- Is designed to restrict the travelling range of a person wearing the safety harness or belt so that the person cannot get into a position where the person could fall off an edge of a surface or through a surface.

Generally, safety belts are better suited for travel restraint than fall arrest purposes.

16.2.3 A roof anchor may be used as a travel restraint on steel sheeting or tiled roofs during construction of the roof. It is lightweight, portable and can be installed and removed with minimal time and effort.

16.2.4 Travel restraint systems can be used in conjunction with other fall protection methods such as guard-rails.

16.2.5 Where it has been planned to use a travel restraint system, the following conditions should be complied before the system is used:

- The travel restraint system should prevent a person falling from the edge of a roof (Fig 16.2). The system should not be used on fragile roofs; and
- Persons setting up and/or using the system should be able to demonstrate that they have a clear and thorough understanding of the system and how the work area can be accessed without the possibility of a fall occurring.

A travel restraint system is not designed to stop or sustain falls.

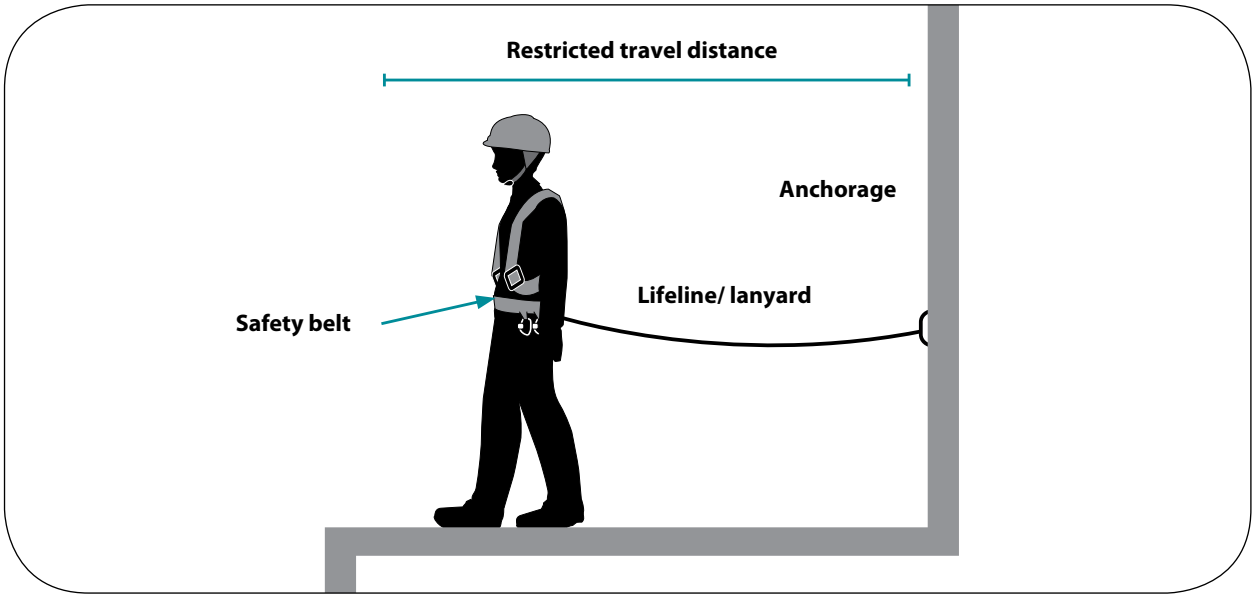

Figure 16.2: The travel restraint system prevents the user from reaching the open side.

16.2.6 Where access to the corner of the roof is required, workers should be attached to two or more sets of ropes and anchorages to prevent a fall from either edge of the roof. While accessing the anchorage points, the users should be restrained so that a fall cannot occur.

16.2.7 The anchorage points must be able to withstand the full weight of the person using it without failure. Anchorage points should be designed for additional loading should more than one person be using the system.

16.2.8 If the system consists of ropes that require their effective length to be adjusted to prevent a fall occurring, the method of adjusting the rope length should be by means of a lockable cam device or similar; if there is a possibility of the rope grab (or similar) coming off the end of the rope, the rope should be suitably terminated.

16.2.9 Safety belts are used only for travel restraint and not for fall arrest purposes. Safety harnesses should be used if the intention is to provided fall arrest instead of travel restraint.

16.2.10 Travel restraint systems are generally only suitable for work such as the following:

- Roof inspection (not on fragile roofs);
- Installation and removal of perimeter guard-rail systems;
- Minor repair work, including replacement of some isolated parts of the roof;
- Painting and cleaning;
- Installations of skylights and ventilation fixtures;
- Pointing up tiles or fitting ridge capping metal roofs; and
- Installation and removal of television aerials and other similar communication equipment.

17. Fall Arrest Systems

17.1 Individual Fall Arrest Systems (Personal Protective Equipment)

17.1.1 Individual fall arrest systems are intended to safely stop a worker from falling an uncontrolled distance and to reduce the impact of the fall. Individual fall arrest systems are an assembly of interconnected components consisting of a harness connected to an anchorage point or anchorage system either directly or by means of a lanyard. They can be used where workers are required to carry out their work near an unprotected edge such as rigging and dismantling. They may also be used where the working platform is not stable, for example in suspended scaffolds.

17.1.2 When used to arrest falls the following guidelines are to be observed:

- The system should be rigged such that if a fall occurs, the distance fallen will be the shortest. This is to minimise the impact and swing of the arrest;
- All fall protection equipment should be visually checked prior to usage (refer to paragraph 17.7);
- Once a fall arrest system has been used to arrest a fall, it must be removed from service and not used again;
- Anchoring of lanyards to guard-rails of scaffolding should be avoided where possible, unless the guard-rail is designed to be able to withstand the force generated by a falling person (about 22.2kN per person attached). If it is absolutely necessary to anchor to the guard-rails, the part to be anchored to must be properly tightened. The vertical pieces are better suited for anchorage than the horizontal pieces.

17.2 Fall Arrest System Limitations

17.2.1 Individual fall arrest systems should only be used if it is not reasonably practicable to use other risk control measures to prevent falls. Individual fall arrest systems require a moderate level of skill to use safely, and in the event of an arrested fall, it may cause some physical injury to the user.

17.2.2 Height clearance is another limitation of individual fall arrest systems. For a person falling from height, the combined length of the lanyard, sag in life line and the shock absorber fully extended may be more than 5m in total. This 5m might be more than the actual height of the fall.

17.2.3 Therefore, when working in areas where falls over short distances are possible, a short lanyard or retractable fall arrest block should be considered.

Anchorage

A safety harness is able to provide protection from falls only if the harness is attached to a lanyard that is anchored.

100 Percent Tie-off

The term '100 percent tie-off' means that anchorage is maintained at all times. This is done to allow for fall protection even when transferring between 2 separate anchorage points. A 100 percent tie-off will require twin-tailed lanyards that allow users to remain anchored to one point of anchorage with one lanyard, while transferring to another point of anchorage with the second one.

Calculation of the Free Fall Distance

Free Fall Distance

The allowable free fall distance for individual fall arrest systems should be limited to not more than 6 feet (1.8m).

Fall Clearance Distance

This is also known as 'free space', it is the total distance below a worker who is using an individual fall arrest system to safely arrest his fall without striking an obstruction or the ground. Below are the formulae for two commonly used configurations.

For a harness, lanyard with energy absorber assembly (Fig 17.1):

> Clearance Height = Length of Lanyard + Length of Energy Absorber Extension + Height of Worker + Safety Distance (usually taken as 3ft/1m)

For a Self Retracting Lifeline (SRL)/Retractable Fall Arresters:

> Clearance Height = Deceleration Distance + Height of Worker + Safety Distance (usually taken as 3ft/1m)

If the individual fall arrest system (fall arrest lanyard or SRL) is attached to a horizontal life line (HLL), the deflection of the HLL needs to be included.

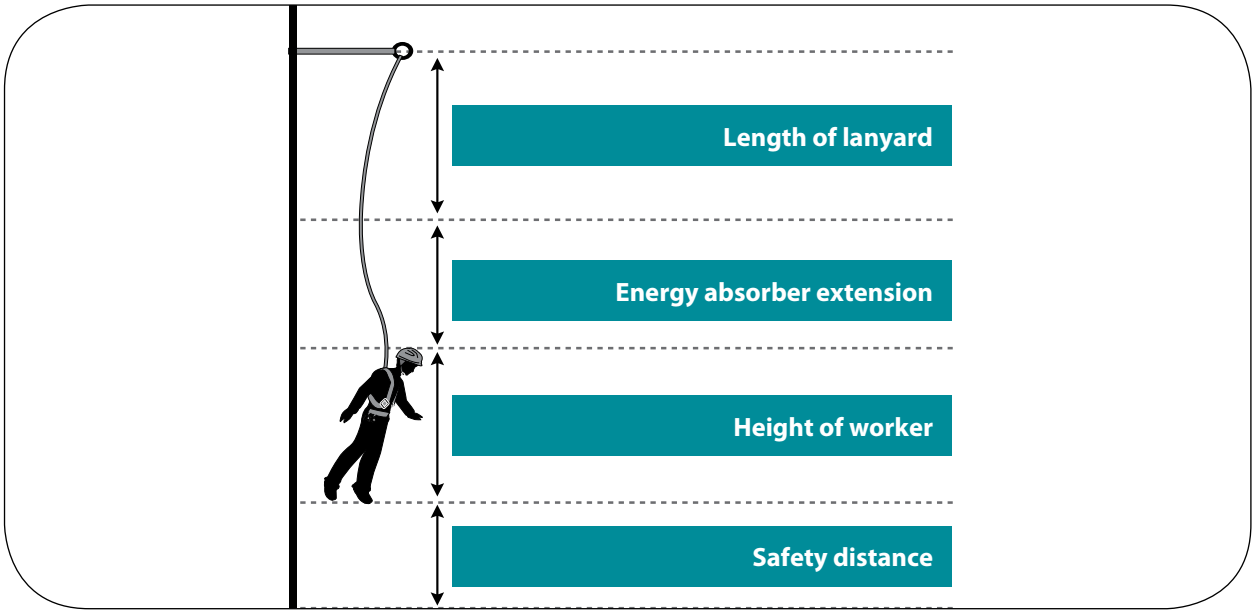

Figure 16.2: A graphical representation of the formula for calculating clearance height.

17.3 Instruction and Training for Workers Using Individual Fall Arrest Systems

17.3.1 Workers required to use individual fall arrest systems should be trained and instructed in:

- The correct fitting and attachment of safety harnesses;
- The dangers of using incompatible hardware;
- The inspection, maintenance and storage of equipment;
- The correct anchorage, installation and use of the system; and
- Emergency rescue procedures.

17.3.2 Upon completion of the training programme, workers should be assessed for their competency in the safe use of the equipment.

17.3.3 The individual fall arrest system is designed to arrest only one fall. In the event of a fall, even if the shock absorber has not been extended, all the components of the fall arrest system should be inspected and approved by a competent person or the manufacturer before it is put to use again. Otherwise, they are to be removed from service.

17.4 Hazards of Fall Arrest Systems

17.4.1 There are some hazards when using the individual fall arrest systems. One such hazard is 'swing back' and 'swing down'. It is caused by the pendulum effect of a person falling off the edge.

17.4.2 '**Swing back**' – In a fall, particularly from a perpendicular edge, the worker will swing back into the building structure and collide with any obstructions in the path of the swing (Fig 17.2, left diagram). If there is a risk of a swing back occurring, the use of an individual fall arrest system should be reassessed.

17.4.3 '**Swing down**' – In a swing down, the arrest line extends diagonally from the anchor point, following the perimeter edge of the roof. If the worker falls, the fall arrest line will slide back along the perimeter until it is at a right angle with the edge of the roof. If the arrest line is too long, the worker will drop and hit the ground (Fig 17.2, right diagram) or the arrest line may break when contacting the edge of the roof and result in the worker hitting the ground.

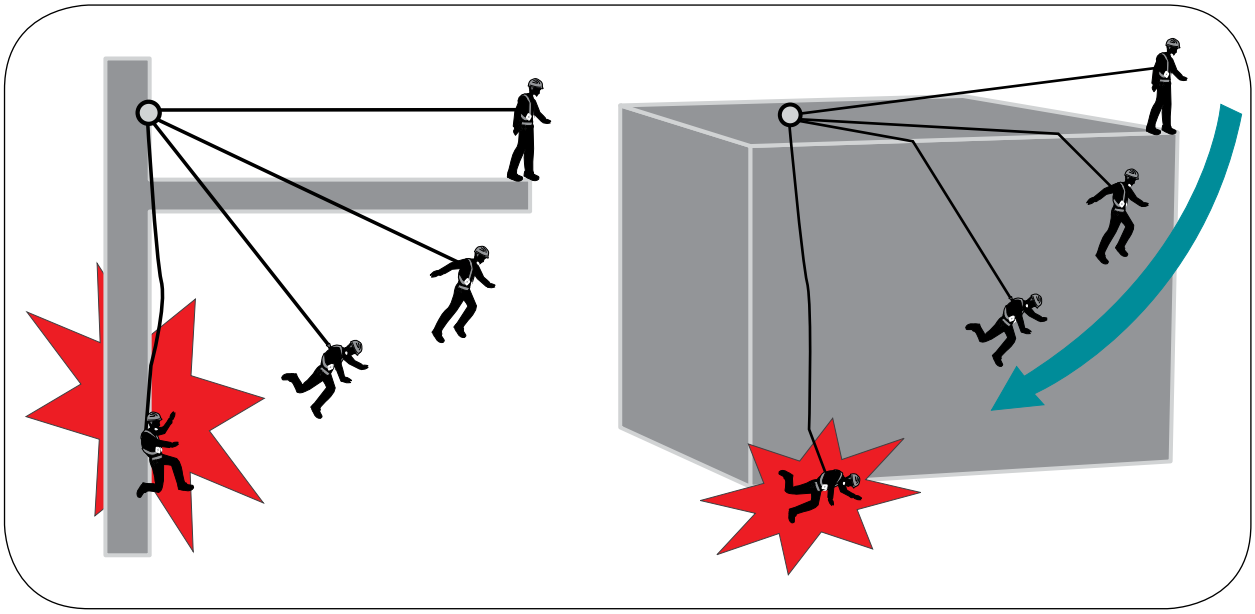

Figure 17.2: Swing back (left) and swing down (right) hazards.

17.5 Rescue of Workers Who are Using Individual Fall Arrest Systems

17.5.1 In the event of a fall, the worker must be rescued as soon as possible. This is necessary to prevent further injury (Refer to paragraph 11.2).

17.5.2 There should be written rescue procedures that must ensure that persons who fall can be rescued as soon as reasonably practicable (if possible, in less than 10mins). The rescue procedures should include plans for:

- Preventing prolonged suspension;
- Identifying symptoms of suspension trauma (light headedness, nausea, paleness of skin, hot flushes, breathlessness); and
- Performing rescue and treatment as quickly as possible.

17.5.3 A person should not use a fall arrest system unless there is at least one other person present on site who is trained to conduct rescue operations in the event of a fall.

17.5.4 It is recommended to prepare specialised rescue equipment that is designed and certified to cope with the additional load during rescue instead of improvising a rescue plan using existing equipment. It must be noted that during rescue, the loads placed on some items of equipment during a rescue may be higher than they have been originally designed for. If equipment is used for rescue either individually or in systems, the supplier should verify that it has suitable performance and loading characteristics in that specific configuration. This applies to all parts of the system, in particular the anchors. The anticipated loads during the rescue situation should be within the loadings specified in the manufacturer's user instructions.

17.5.5 Certain situations may require at least two persons to safely rescue the fallen worker. The rescue procedure must not put the rescuers at risk. If a mobile elevated work platform is to be used for a rescue, it should be readily available at all times should a person be using an individual fall arrest system.

17.6 Fall Arrest System Components (Harnesses, Lines and Lanyards)

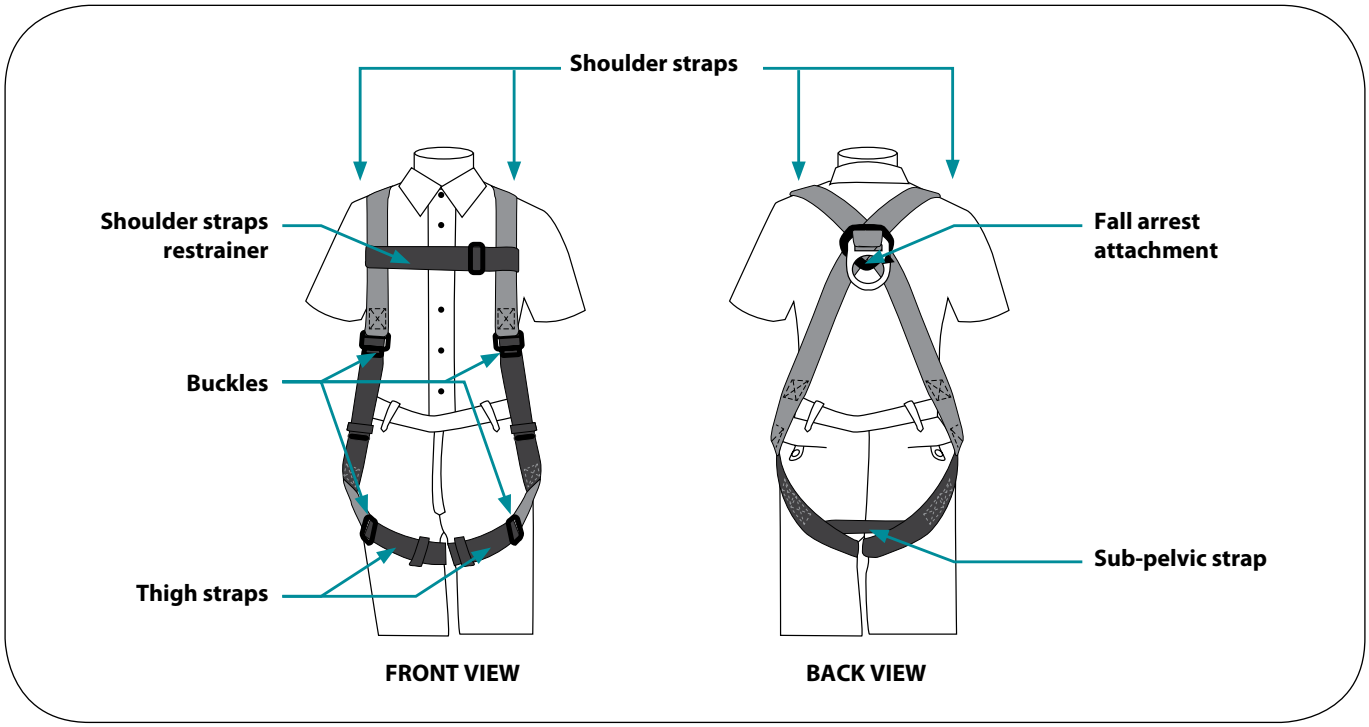

Figure 17.3: Components of a fall arrest harness.

17.6.1 A fall arrest harness (Fig 17.3) is an assembly of interconnected shoulder and leg straps with or without a body belt designed to spread the load over the body and to prevent the wearer from falling out of the assembly.

17.6.2 A lanyard is a line used, usually as part of a lanyard assembly, to connect a fall arrest harness to an anchorage point or static line. A lanyard assembly should be as short as reasonably practicable.

17.6.3 A fall arrest static line is a horizontal or vertical line of a fall arrest system. The line is connected to a fixed anchorage point at each end, to which a lanyard can be attached. The line can be made of metal tube, metal rod, steel wire rope, synthetic webbing or synthetic rope.

17.6.4 A personal energy absorber is used in conjunction with a fall arrest harness and lanyard to reduce the deceleration force imposed by a suddenly arrested fall and correspondingly reduces loading on the anchorage. The energy absorber may be a separate item or manufactured into the lanyard.

17.6.5 Further information for standards of fall arrest systems can be obtained from the following standards issued by SPRING Singapore:

- **Singapore Standard SS 528 – 1** : 2006 Personal Fall Arrest Systems. - Full-body harnesses
- **Singapore Standard SS 528 – 2** : 2006 Personal Fall Arrest Systems. - Lanyards and energy absorbers
- **Singapore Standard SS 528 – 3** : 2006 Personal Fall Arrest Systems. - Self-retracting lifelines
- **Singapore Standard SS 528 – 4** : 2006 Personal Fall Arrest Systems. - Vertical rails and vertical lifelines incorporating a sliding-type fall arrester
- **Singapore Standard SS 528 – 5** : 2006 Personal Fall Arrest Systems. - Connectors with self-closing and self-locking gates
- **Singapore Standard SS 528 – 6** : 2006 Personal Fall Arrest Systems. - System performance tests

17.7 Inspection of Fall Arrest Systems

17.7.1 The inspection of fall arrest systems by a competent person should be conducted periodically and include the following:

- The rope or webbing including the anchorage lines (e.g. inspecting for any defects or damage and checking the anchorage);
- The fall arrest system harness body (e.g. inspecting for any damage to the mounting ring or the body, checking the activation of the fall arrest indicator and that the labels are present);
- The locking mechanisms and rope guides (e.g. inspecting the visible rope guides for excessive wear and checking that the rope runs freely through the anchorage and that the locking mechanism works properly); and
- The hardware (e.g. checking that the snaphooks or links work properly).
- That the PPE or its components have not exceeded the manufacturer's recommended usage life.

Marking or Labelling of Textile Components on PPE

Solvents present in markers may damage or weaken textiles and may result in the protection provided by the PPE to be compromised. As a general rule, textile products must not be marked unless it has been ascertained that the marking agent will not cause damage to the textile.

17.7.2 When doing pre-use checks for lanyards and flexible anchorage lines (textile based equipment), the competent person performing the inspection should pay particular attention to the following:

- Cuts and frays;
- Excessive wear;
- Abrasion (furriness) , particularly to load bearing parts;
- Stitching (unauthorised repair);
- Discoloration (sign of chemical or UV damage);
- Powdery surface (damage by chemicals);
- Hardening/stiffness;
- Heat glazing/burns (damage by heat);
- Dirt, oil, grease;
- Age;
- Flattening/thinning; and
- Lumps.

17.7.3 When doing pre-use checks for harnesses, the competent person should pay attention to the following:

- Inside and outside any textile attachment point loops for all the features listed under the checking procedure for textile based equipment above;
- Fastening and adjustment buckles as well as any other safety critical metal and plastic parts for:
  - Correct assembly;
  - Correct functioning;
  - Excessive wear;

- Corrosion;
- Cracks;
- Other damage.

17.7.4 When doing pre-use checks for connectors (Fig 17.4), such as snaphooks, the competent person performing the inspection should take note of:

- Obvious damage or deformations (bent, twisted, corroded, worn, cracks etc.), especially at contact points;
- Rust/corrosion;
- Contamination by chemicals (pitting or flaking);
- Build up of foreign matter (grit, grease or paint);
- Cuts/serrations/burring, heavy marking or scoring;
- Hinge pin (ensure it is in good condition);
- Catch pin (ensure it is not bent); and
- Functionality of moving parts such as locking mechanisms.

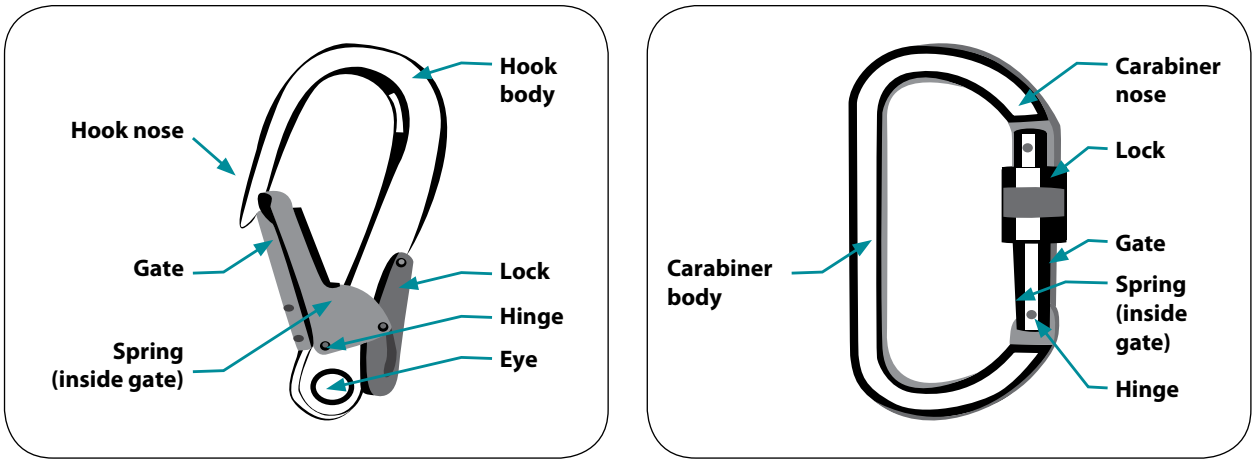

Figure 17.4: A diagram of a self-locking connector or snaphook (left) and a carabiner (right).

17.7.5 When doing pre-use checks for shock absorbers, the competent person should take note of any:

- Signs of activation; and
- Wear and tear of point of attachment.

18. Ladders and Step Platforms

18.1 Ladders and Step Platforms

18.1.1 Ladders leaning against a supporting structure should be set up on a level area on firm footing and the base should be located a distance from the wall approximately a quarter of the vertical height of the ladder (Fig 18.1).

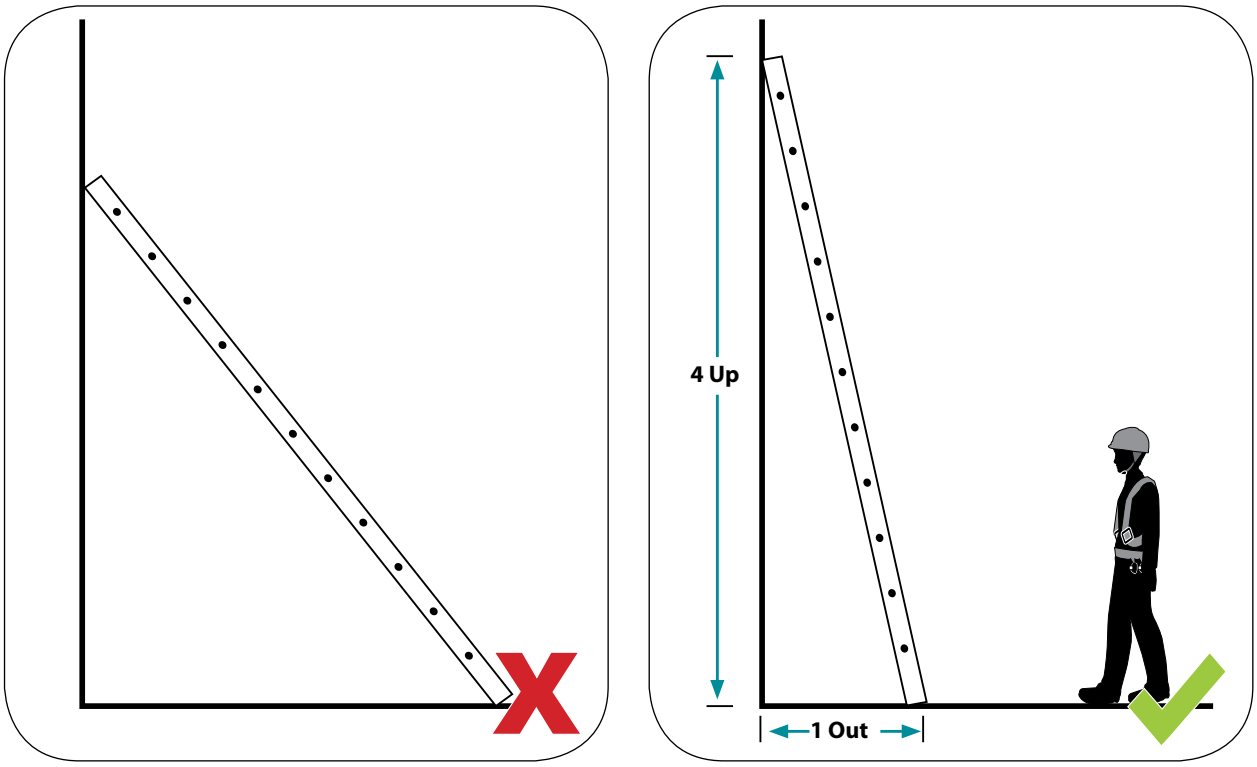

Figure 18.1: The ratio of the height to the base for a correctly positioned ladder is 4:1.

18.1.2 Where a ladder is used as a means of access or as a working place, adequate handholds should be provided to a height of at least one meter above the place of landing of the highest rung to be reached by the feet of any person working on the ladder.

18.1.3 Persons on ladders should maintain three points of contact at all times, e.g. two feet and one hand or two hands and one foot (Fig. 18.2).

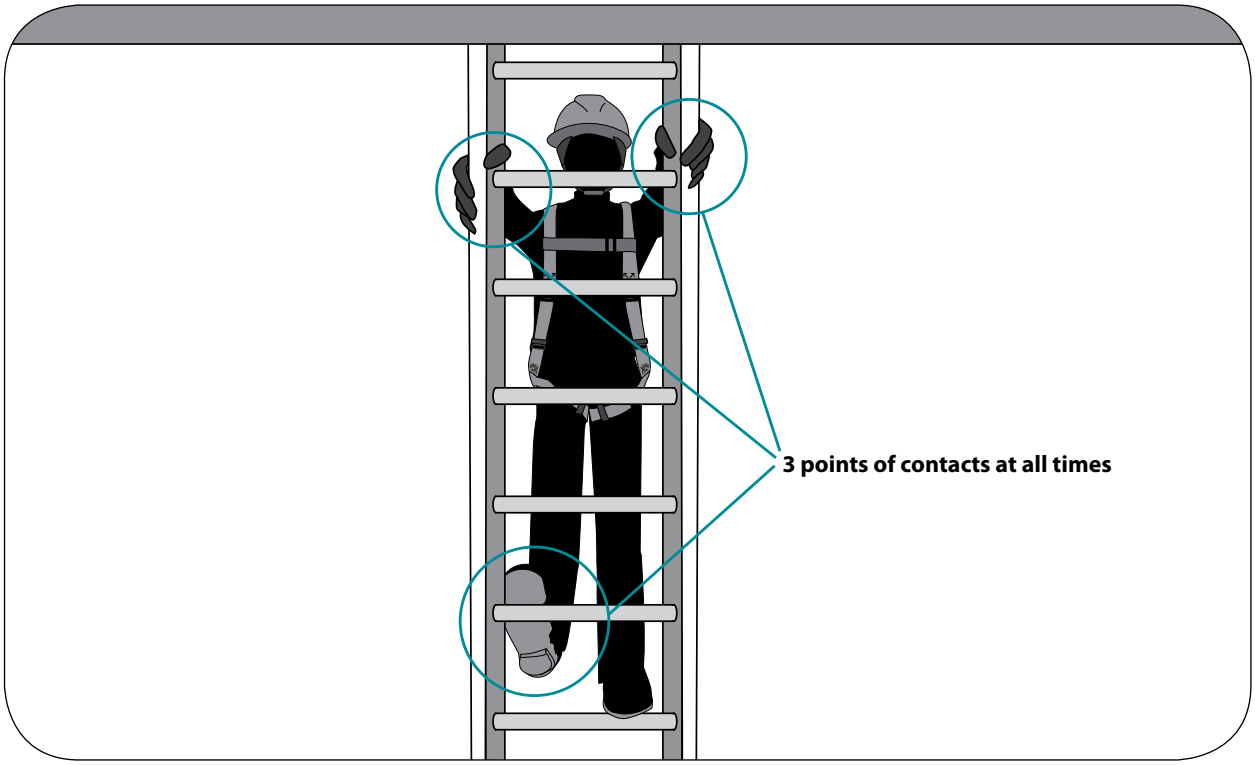

Figure 18.2: Three points of contact with the ladder should be maintained at all times, Tools and materials should not be carried by hand and should be in a tool belt or side pouch.

18.1.4 Fall prevention measures may be necessary in association with the use of ladders if a risk assessment shows that additional protection is necessary. For example, permanent ladders are fitted with protective back guards. In addition, pole straps may be necessary while working from ladders.

18.1.5 If the ladder is more than 3m in length, it should be securely fixed (e.g. ladder lashing). If it is impracticable to do so, a person should be stationed at the base of the ladder to prevent the ladder from slipping or falling.

18.2 Portable Ladders

18.2.1 Ladders should be used as a means of access to or egress from a work area and not as a work platform.

18.2.2 Step and trestle ladders should only be used when they are in the fully open position. A step ladder may be used in the closed position by leaning it against a support. However, care should be taken to ensure that only the front stiles carry the load. Only trestle ladders are to be used to support work platform upon which a person has to work.

18.2.3 Standing on top of a step ladder (Fig 18.3, left diagram) is highly unsafe and should never be done. If it is necessary to work from a step ladder, work a few steps below the top rung, so that a handhold can be maintained. Do not overreach and keep both feet on the same step throughout the task.

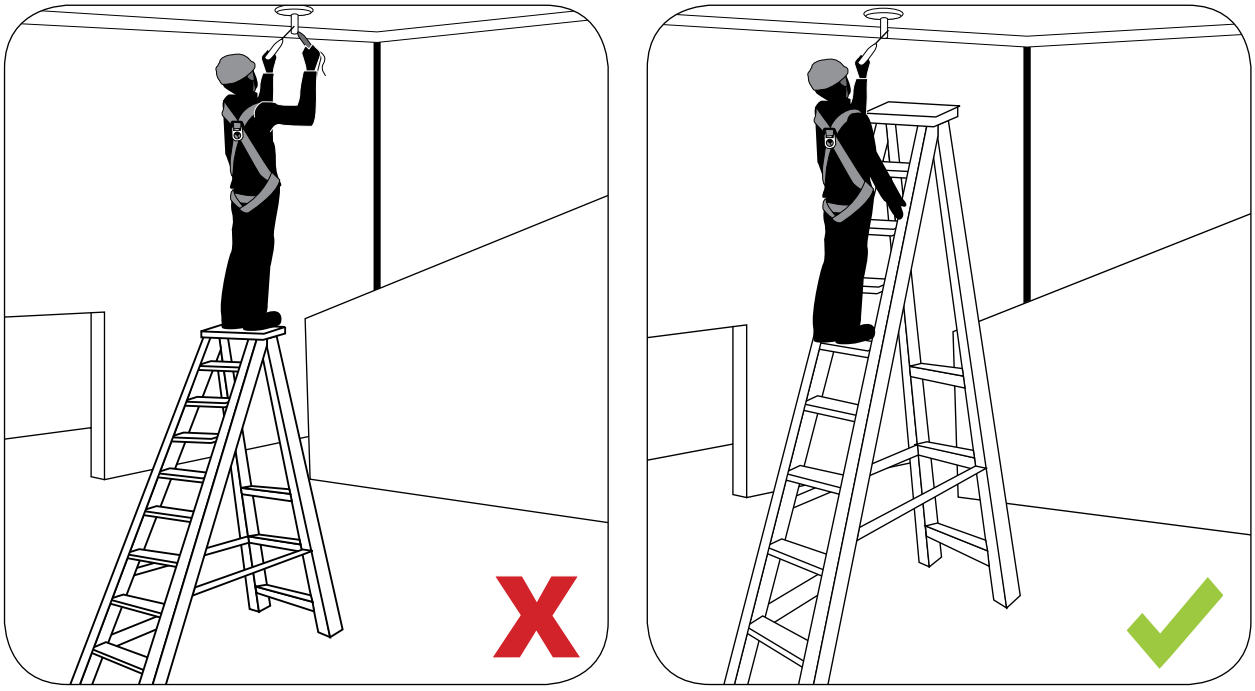

Figure 18.3: If it is necessary to work on a step ladder, work a few steps below the top rung, so that a handhold can be maintained.

18.3 Step Platforms

18.3.1 A step platform (Fig 18.4) is a safer alternative to a step ladder especially when the task involves extended periods working at height or with restricted movement and vision (e.g. welding). A step platform is more stable and provides a much larger work surface than a step ladder.

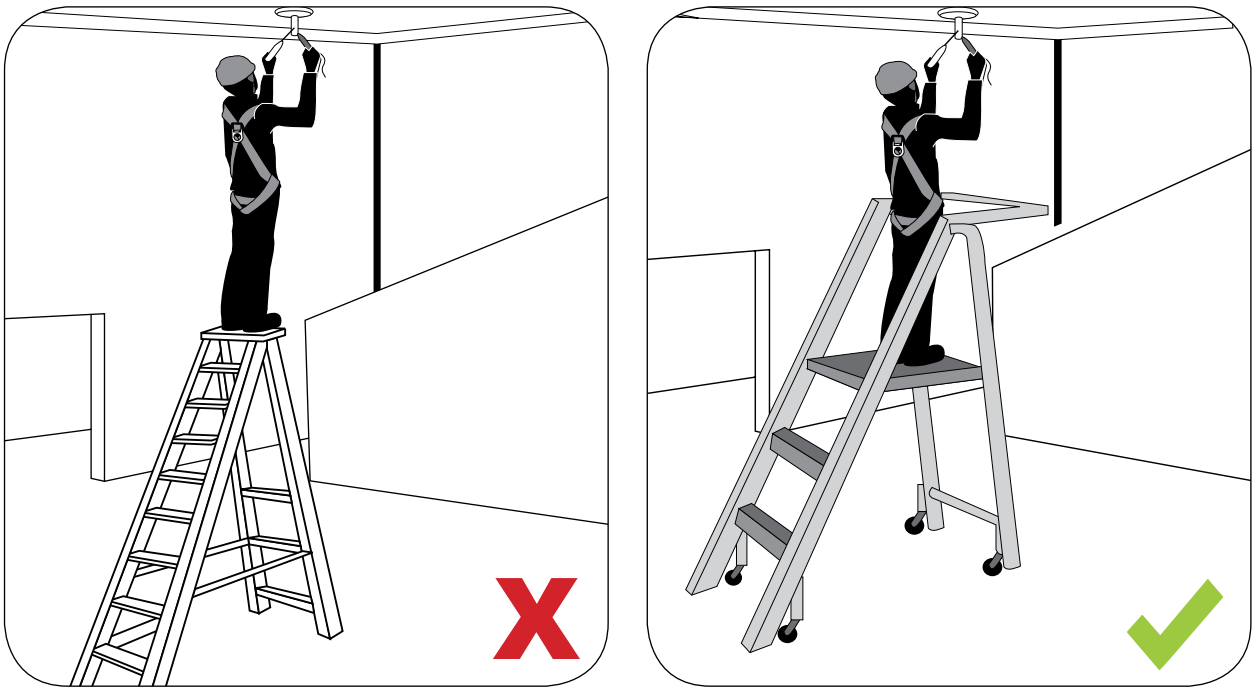

Figure 18.4: A step platform can provide a more stable work surface.

18.4 Safety Guidelines for Ladders

18.4.1 Observe the following safety guidelines when using ladders:

- Use a 2-person team to transport ladders that are greater than 2m in height, carry the ladder close to the body at elbow height;
- Perform a check on the ladder before using it, refer to paragraph 18.4.3 for details;
- Do not paint or coat ladders such that flaws are unable to be spotted by users;
- Do not handle or use ladders where the workers or the ladder may make contact with power lines, or use metal or reinforced metal ladders in the vicinity of live electrical equipment;
- Do not set up ladders in passageways, doorways, driveways or other places where a person, vehicle or crane lifted load can hit it. (if the use of ladder is unavoidable, erect a barrier or lock the door shut or as a last resort, a person standing at the base);
- Do not use the step ladder near the edge of an open floor or on scaffolding to gain extra height; if the ladder topples, the worker could fall over the edge;
- Do not carry materials and tools by hand when ascending or descending the ladder. Materials or tools which cannot be safely secured on the worker's belt should be independently transferred or hoisted to the work station;
- Do not work on the ladder continuously for extended periods of time (recommended work time: 10-15 mins);
- Do not use a ladder for heavy or strenuous work;
- Do not overreach when working on the ladder;
- Do not do work that will impose a side loading on a ladder unless the ladder is secured;
- Do not work directly over other workers' work areas;
- Do not allow anyone else to be on the ladder at the same time;
- Do not use ladders during strong wind or wet conditions; and
- Do not use the ladder unless slip resistant footwear is being worn.

18.4.2 When securing a ladder:

- Ensure that the ladder is on firm ground or spread the load (e.g. place a board at the bottom of the ladder);
- For A-frame ladders, ensure that both spreaders are straightened and firmly attached before use. They must be locked firmly in the open position.
- Tie the ladder to a suitable point making sure that both stiles are tied (Fig 18.5).
- If this is not possible, then securely wedge the ladder e.g. against a wall;
- If none of the above can be achieved, foot the ladder (Fig 18.6) (footing is the last resort and should be avoided if other means of access can be used).

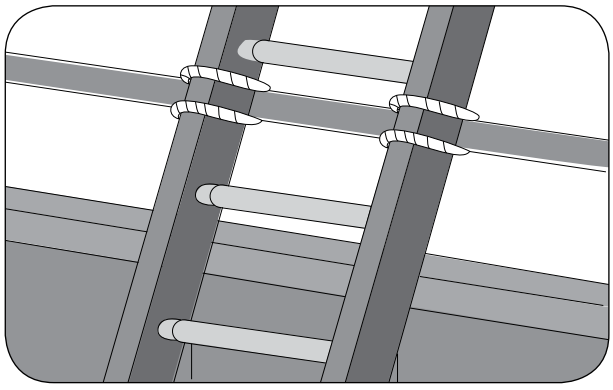

Figure 18.5: A ladder with both stiles secure.

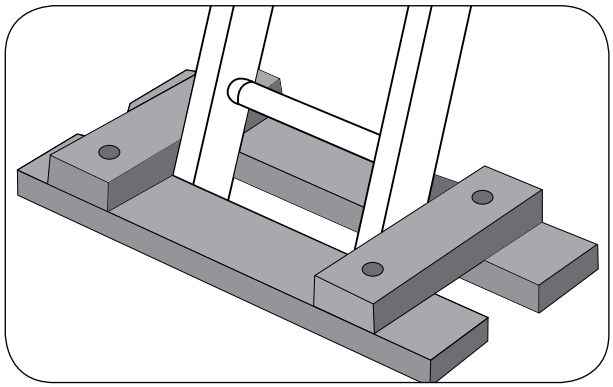

Figure 18.6: Footing the ladder.

18.4.3 Do not use ladders with any of the following faults:

- Timber stiles that are warped, splintered, cracked or bruised;
- Metal stiles which are corroded, twisted, bent, kinked, crushed, or with crack welds or damaged feet;
- Rungs; steps, treads or top plates which are missing, worn or loose;
- Tie rods missing, broken or loose;
- Ropes, braces or brackets which are missing, broken or worn; and
- Timber members which are covered with opaque paint or other treatment that could disguise faults in the timber.

18.4.4 Ladders can be checked for serviceability by;

- Taking each end of the ladder in turn and trying to push the stiles apart and then together. Any movement indicates insecure rungs or loose tie rods;
- Laying the ladder flat, raising one end and attempting to push one stile while pulling the other. If the stiles move relative to each other, the rungs are loose; and
- Tapping timber rungs with a mallet. A dull sound is an indication of a defective rung.

19. Hazards of Working at Rooftop

19.1 Fragile/Brittle Roofing

19.1.1 Persons standing on fragile and brittle roofs are at risk if the roofs break and give way under the loading of the persons' weight. These roofs typically include those that are constructed from moulded or fabricated materials such as cellulose cement roof sheets; glass; fiberglass; acrylic or other similar synthetic materials.

19.1.2 If a person is required to work on or from a roof that is fragile and can break easily, it is important to ensure that:

- Before the roofing work is carried out, the brittle or fragile areas are identified and the stability of the structure and soundness of the roof is assessed as part of the risk management process;
- The worker is informed that it is a fragile or brittle roofing;
- Safe access to the work area is provided to enable workers to step directly onto a safe platform or area;
- Work is carried out from a working platform that is located and constructed to allow work to be performed safely (Fig 19.1);
- An adequate fall arrest system is installed and used;
- There is another person present at all times when work is being performed on a brittle roof in case there is an emergency;
- Training and instruction has been provided to workers on precautions to be taken;
- Training in rescue techniques has been provided and rescue equipment is readily available for use at the workplace;
- Warning signs are displayed at access points to any work area where fragile material is present (Fig 19.2);
- Warning signs are fixed securely in a position where they will be clearly visible to persons accessing the working area.

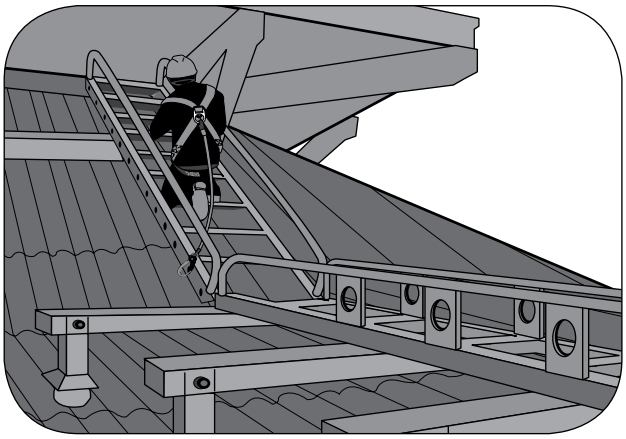

Figure 19.1 Left: Crawl boards, gangways and perimeter guard-rails can enhance safety for work on fragile or brittle roofs.

Figure 19.2 Left: Danger signs to be fixed at points of access to the roof.

20. Acknowledgements

The Workplace Safety and Health Council would like to thank all who had commented and contributed in any way to the improvement of this Code of Practice.

21. List of References

1. Australian Government NOHSC - National Code of Practice For The Prevention Of Falls From Heights In Construction Work 2004

2. Government Of Western Australia Commission For Occupational Safety And Health - Code of Practice Prevention Of Falls At Work Places 2004

3. Worksafe Victoria Code of Practice No.29 – Prevention Of Falls In Housing Construction 2004

4. Worksafe BC OHS Regulations – Guidelines Part 11 Fall Protection

5. Royal Gazette Of The Province Of Nova Scotia (Canada) – Fall Protection And Scaffolding Regulations Made Under Section 82 Of The OHS Act S.N.S 1996,C.7 O.I.C. 96-14 (January 3, 1996), N.S. Reg 2/96

6. OSHA Regulations (Standards – 29 Cfr) – Sample Fall Protection Plan – Non Mandatory Guidelines For Complying With 1926.502(K) – 1926 Subpart M App E

7. HSE Safe Use Of Ladders And Step Ladders – An Employer's Guide

8. HSE The Work At Height Regulations 2005 – A Brief Guide

22. Other Useful Contacts

To report unsafe practices at the workplace. please call the MOM hotline at 6317 1111.
To report accidents, dangerous occurences and occupational diseases, visit www.mom.gov.sg/ireport.

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